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Recording Unexpected Losses

THE usual elements of operating expense can be forecast with some accuracy. Labor and material costs and the wastes of depreciation fluctuate between bounds that are sometimes surprising but are capable of approximation in the estimates for the year. A loss which cannot be provided for with any assurance that it will be adequate is that which comes from storms. New York and the nearby Eastern seaboard districts had a costly experience last week which caused expenses to mount while the stoppage of service lessened revenues. So far as such losses can be tabulated records of them should be preserved in the data of public-utility companies. Both extra expenditures and conservative estimates of missed revenue are essential. They will be found useful in rate-making cases.

Market Prices and Investment Costs

IN many unexpected ways central stations have been affected by the European war. Their sources of capital, the markets for their output and the prices of the materials which constitute their physical equipment have undergone distinct changes. These changes in many instances are radical, and they mean that new policies or methods must be adopted. One of the indirect war results which is important to some companies is the opportunity for the sale of aluminum wire at a high price. The large advance in the aluminum market has made it advantageous to replace wire manufactured of this metal with copper. Notwithstanding the present advanced level of copper, which does not generally stimulate consumption by the electrical industries, this process assures a substantial reduction in capital cost, and it has appealed to various companies. The details of the substitution in Rochester and the saving effected thereby, which are presented elsewhere in this issue, are suggestive.

Reflex Influences of War and Engineering

IT is becoming commonplace to say that warfare to-day is engineering and that the European conflict is a war of machines. In stating these the third and corollary conclusion, however, is sometimes forgotten. If war to-day is and in the future is to be applied engineering, its machines for destruction need "operators" as well as designers. That these "operators" must have engineering knowledge and training is recognized by military and naval commanders. There is no question that the civilian engineer has a wider opportunity for patriotic service than any one group of men in the nation. This in itself is a sobering thought. If we analyze the broad statement of fact, we come also to another conclusion that may have a broad influence in shaping engineering applications not only in the art of war but also in the art of peace. Two factors are prominent in applying engineering to the advancement of commerce and industry—cost and quality. An engineer in commercial pursuits searches for ways and means to carry forward his work with these two factors prominent, the need to reduce costs having to be balanced against quality. When, however, he comes to look at the problems of war he finds that "time" and "quality" rather than "cost" and "quality" are the prime elements. Cost must be secondary and time and quality primary. Exchange of ideas which is bound to come between civilian engineers, on the one hand, and military and naval engineers, on the other, may logically and properly affect the motives for design in both. Civilian engineers may bring to their work in war the knowledge of standardizing forced by cost competition, which will save time. In their turn they will bring away a new conception of the value of quality, which may be called the moral motive in design. One group will learn that standardizing is not inconsistent with quality, and the other that time and quality often outweigh cost.

The Situation in the Electrical Industry

RECALLING the hesitation and doubt in the predictions made one year ago, the industry finds abundant cause for gratification in the financial results which, notwithstanding the world-wide unrest, were attained in 1915. It looks toward 1916 with far greater confidence in the future than it felt twelve months ago. The intervening year, though filled with reminders of the devastating European war, has witnessed an unforeseen and unprecedented industrial development. And the reflex of this development is found in the well-maintained central-station earnings, the enlarged output and better prices of electrical manufacturers, and the improved business of contractors and jobbers. It had a striking manifestation in the Electrical Prosperity Week movement, which turned retail buying for the entire holiday season into electrical channels more successfully than ever before.

As we reach the customary stock-taking period there is a new realization of the sources of inherent strength found in the industry. Its fortunate diversification of application is impressed anew as a factor in stability and development. And in this season of inventory some previously unappreciated sources of economy in the use of capital investment and in operating expense rise

prominently to the surface. The industry has learned more thoroughly how to apply the same knowledge of intensive cultivation which is effecting a peaceful revolution in farming methods. It is making the dollar of investment more productive.

Our internal questions in the industry are partly obscured by the flood of prosperity orders which followed the restricted buying of the earlier war months. We hear less of local public-policy issues, less of operating problems, more of questions which are commercial in nature. There is more discussion of the effect of the war upon the international financing of American electrical enterprises and of the newly revealed position of the industry and its vast body of executives and workers as a factor in the "preparedness" policy of the nation. Thus far the industry has met the demands upon it with inventiveness, energy and ambition. Satisfied though it is with the achievements of 1915, it has learned from them that greater possibilities lie ahead.

Getting the Utility's Side Before the Public

IN numerous cases brought before commissions the public has little perception of the problems controlling a given service, rate or investment. This is to be expected. The public is not interested in the problems of the central station or electric-railway manager until it is shown exactly how some of these difficulties affect the rendering of a specific service, how they set certain limits to rates, or how they run up the totals of a plant investment. When this information is made clear, reasonable men become less hostile to the company. They acquire the art of looking at two sides of a question upon which they were already committed. From this point they often go forward to a state of mind perhaps not convinced at once of the justice of the company's case in detail but all the more willing to trust the decision to the superior knowledge and judgment of the commission and certain of the company's desire to be fair.

To the company commission hearings are often costly in the time of executives and subordinates alike, but they afford an opportunity in many cases to disarm prejudices which the far-sighted managers have not been slow to seize. Commission proceedings are usually much broader in scope than those of the courts, the range of inquiry is very much wider, and the scope of information brought forward is more comprehensive. Therefore no manager need shrink from straightforward explanations even where his opponents are represented by lawyers with engineering training—a class of practitioners of which we are likely to hear more.

In two recent cases involving petitions for the right to charge higher rates the utilities submitted printed briefs to the commission, setting forth the facts and reasons why they believed their petitions should be granted. When a company goes to the expense of putting its case squarely up to the public no less than to the regulating body, it invites better understanding, encourages co-operation and builds for its future. The preparation of a brief cannot always be concise and simple enough for its equal utilization by public and by commission; but, by whatever method, the willingness of a company to make its position as clear to its opponents as to the board, the entire abandonment of concealment in its policy, and the maintenance of good-natured helpfulness at every stage of the proceedings, are demanded to-day by the high plane of fair regulation which all parties to such cases should strive to attain.

A Growing Market for Appliances

LAST Christmas the sale of electric gifts was very large, and every gift that entered a home helped spread the influence of the "Do it electrically" idea. Month after month in the meantime the many manufacturers have made and sold by thousands every kind of household heating device and have spread the leaven further. Steadily, with unremitting vigor and persuasion, the national advertising that has come to be so conspicuous a feature of our popular magazines has held its constant pressure of publicity and by constructive education developed thousands of permanent converts. It is a process of accumulation that will show itself this Christmas in tremendous increase in the sales of everything electrical, for it has actually created an increased market greater than has ever been experienced before. It has been estimated that more than $100,000,000 is spent each year in this country for Christmas gifts. Here is reason enough for any man why he should strive to tie more closely to this market evolution by establishing himself as the recognized local headquarters for electrical household utilities.

The Factory Lighting Code

INDUSTRIAL lighting practice has recently been summarized in both the United States and Great Britain in compact codes. Both the codes, the former reviewed in the Nov. 20 issue of the ELECTRICAL WORLD and the latter in this number, mark the advance of applied engineering in the lighting field, and each is a long step forward in bringing down to a simple common-sense basis the fundamental requirements for the illumination of factories. In these days, when the highest possible efficiency in manufacturing operations is sought and when it often happens that industrial operations are carried on twenty-four hours per day, lighting assumes a new importance, both with respect to the amount of output and, particularly, as regards its quality. Poor illumination means not only slower work, but work which on the whole is less likely to pass close inspection. The American code is drawn up to give, in the first place, an outline of general conditions such as can be with advantage used as a basis for legislation and general regulation of conditions, and beyond this it covers a very wide range of extremely practical suggestions dealing with the actual solution of the often difficult factory problem. Daylight, as well as artificial, illumination is included in the specifications. This is a matter of considerable

importance, inasmuch as it is a subject about which there is very little popular knowledge. Few indeed, outside a small list of skilled architects and constructors, appreciate the daylight-lighting situation at anything like its full value.

The great movement for safety in industrial operations is concerned in no small degree with suitable illumination, for over and over again it has been pointed out that accidents increase during the time when artificial light is in use unless that light is plentiful and well arranged. Dangerous machines in particular require extra attention in providing suitable lighting. In fact, the prevention of accidents is one of the soundest reasons for legislative regulation of the lighting of factories and mills.

The Development of a Small Network

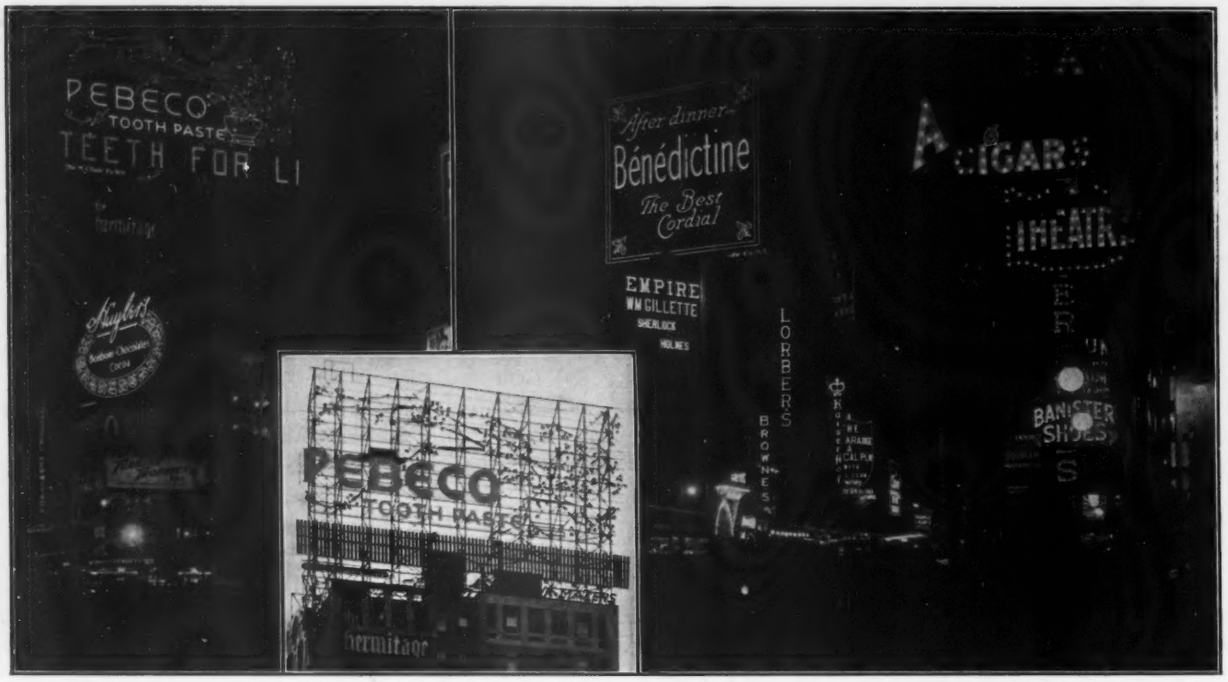
A VERY useful example of scientific power distribution to a group of small communities is exemplified in the Michigan system described elsewhere in our columns. The new Barton station is the one immediately concerned, but its chief importance rests in the fact that it is part of a coherent development covering fifteen or twenty communities and consisting of four hydroelectric plants with duplicate connections to the two big steam stations of the Detroit Edison Company at Delray and Conners Creek. The Barton plant itself is a well-designed low-head plant containing two 2300-volt, three-phase generators with vertical shafts, one of 1000 kw. and the other of 500 kw. The turbines are set in open-scroll-case wheel pits and furnished with concrete draft tubes, and the turbines themselves under test have shown an unusually high efficiency.

More important to the development of the art than any excellent features introduced in this particular plant is the general scheme of combined operation which is being carried out with the four hydraulic stations. All together have a conjoined rating very much less than that of the two modern steam plants with which the system is connected, although the hydraulic plants themselves are developed for considerably more than the average flow of the stream. The result of this proportion is that the hydraulic plants can always be utilized to their fullest capacity, as determined by the stage of the water, so that all the energy generated can be effectively utilized on the system and any surplus can go to add hydraulic power to the connected plants if necessary. When the water is low the connections permit all the additional power required to be derived from the steam plants. In fact, the system may be considered as a steam-operated one with a hydraulic auxiliary, rather than as a hydraulic plant with a steam auxiliary. The effect of the situation is to obtain at all times economical service owing to the high efficiency of the steam machinery, while in so far as they can be utilized the hydraulic plants stand by still further to lower the cost of energy. Then, too, the water-powers, which are as yet only partly developed, are arranged to pull together in the sense not only of common utilization but of co-operative design. For instance, the Barton plant, just referred to, has two units of different sizes.

A hydraulic plant with only two units, and these of different sizes, would generally be regarded as an anomaly by those unfamiliar with the strategy of hydraulic development. In fact, where a number of plants are co-operating on the same system each serves as a reserve for the others in time of need, and the main thing is to utilize the power available at each plant in the most efficient manner possible. There is not the slightest need of allowing for special reserve capacity in any one of the interconnected plants, provided that there is adequate total reserve at hand. In this case it is supplied by the steam-plant connections. Therefore it is good judgment to work each individual plant as efficiently as possible, quite irrespective of reserve and in defiance of that obsession of uniformity which has instigated no small amount of bad engineering. Interchange of units is a matter of trivial importance where all are working together, and if anything goes wrong beyond the ability of the remaining machines in all the plants to overcome, the big steam reserve is at hand to tide over any and all emergencies. Conditions might chance to be such that uniformity would be a very good thing and would lead to the highest operative efficiency, yet it is not necessarily a good thing in itself, but only in so far as it tends to effective operation. We lay stress on these matters because they have a direct and special bearing on the growth of the small networks which can so efficiently utilize the less important water-powers of the country. Success in their utilization implies full interconnection, cheap and simple plants, and small operating forces. Cases may even arise when the same operating force may be utilized in two stations, one of the pair being shut down at certain stages of the water, or even at certain hours of the day, to permit the filling of its pond. These comparatively small systems frequently offer a wide scope for tact and originality in engineering as well as for most skillful and successful operation.

Editorial Announcement

A LARGE part of the present number, the fourth issue for December, is devoted as usual to articles on commercial subjects having as their purpose the widening of the applications of electricity as well as the suggestion of improved methods for the sale of electrical appliances and electric service. Last week, in the engineering number, special emphasis was laid on technical advance in the industry. Next week, in the Jan. 1 issue, continuing the ELECTRICAL WORLD'S custom of many years of presenting annual reviews summarizing the progress of the past twelve months, there will appear a group of interviews with and articles by leaders and experts in their respective branches of the industry, indicating in particular plans and expectations for 1916, based upon the experience and achievements of the year now drawing to a close. In the second issue of January, in accordance with the usual plan, special emphasis will be given to the problems of an engineering nature that are met with in operating practice.



New York's White Way Ablaze with Many New Electric Signs as Holiday Visitors Throng the City's Theater District

In striking contrast with the semi-darkness in which many of the metropolitan centers abroad are now nightly shrouded for protection against airship raids, New York's "great white way" is this year aglow with even more brilliant electric-sign displays than in preceding seasons—the spectacular lighting reaching a climax this year as usual about Christmas week, when the theater district is thronged with holiday visitors. New roof displays compete for attention on both sides of Broadway from Thirty-fourth Street to Columbus Circle. Of chief interest among those recently erected is the new "motograph" sign which overlooks Times Square and is pictured at the left. Across its face, in an unending flow, run the words of the advertising legend, like giant newspaper text viewed through a reading glass held in the observer's hand. As in the case with the similar signs which have been running for some months at Detroit and Chicago, the Times Square motograph sign is operated by a perforated paper record—not unlike a piano-player roll—through the perforations in which contacts are made to light successively the lamps of the banks on the slat-like structure shown in the day view above, producing the effect of the running letters. Another new display which looms large on the Broadway skyline is the "Benedictine" sign pictured above. Set off in an effective border softened by color-caps, the principal letters of the "Benedictine" sign measure 14 ft. in height and the smaller letters measure 5 ft.

A Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

Ferris Bill Approved by House Public Lands Committee

The Ferris bill for the development of water-power on the public lands under fifty-year leases to individuals, associations or corporations has been ordered favorably reported by the House public lands committee, which had before it a letter from Secretary Lane approving the measure. In his letter to the House committee Secretary Lane said:

"The failure to utilize the water-power resources is an economic waste. Coal, oil, gas and timber, which could be conserved for the future or for use in localities where power is not available, are now being consumed in places where inexhaustible water-power could be had. Lands which would produce abundant crops under irrigation are lying arid and unproductive because of the failure to develop hydroelectric power which would pump water to them.

"The nitrates in the atmosphere, a source of wealth and the means of providing for the rejuvenation of existing soils and of providing an available supply of necessary materials for war or preparation for war, continue unused because of the lack of cheap and extensive power development. Available capital lies idle because it will not be hazarded upon the revocable-permit law."

Naval Consulting Board Recommends Nitrate Plant

The establishment of a government plant to make nitric acid out of the air for use in manufacturing smokeless powder, in case our supply of nitrates, which now comes entirely from Chile, should be cut off by war, was recommended in a report sent Wednesday night to Secretary Daniels by the Naval Consulting Board, which held sessions Wednesday at the Engineering Societies Building, New York City.

Dr. L. H. Baekeland, chairman of the committee on ordnance and explosives, said that unless this country had such a plant all of the preparedness in the way of big guns could be speedily rendered useless by an enemy able to seize the Chilean ports or to interfere with ocean traffic between this country and Chile.

The plan is that the government shall take possession of water-power somewhere in the interior, inaccessible to an invading enemy, and there erect a plant to make nitric acid from the air and experiment in order to obtain the best and cheapest methods.

Since nitrate cannot be taken from the air at an expense small enough to make it a profitable enterprise, it is absolutely necessary, according to Dr. Baekeland, that the United States government should undertake to develop it. The United States is almost entirely self-

dependent as far as the productions of things necessary to war are concerned, with the exception of nitrates, which are really the most fundamental of all. These are brought from Chile.

INDIANA ELECTRIC PROPERTIES MERGE

Northern Indiana Gas & Electric Company to Take Over Plants of the General Service Company and Indiana Lighting Company

Papers were filed Dec. 20 at Indianapolis, Ind., whereby the Northern Indiana Gas & Electric Company, of which C. H. Geist is president, petitioned the Public Service Commission of Indiana for authority to purchase the plants and property of the General Service Company and the Indiana Lighting Company, in which Samuel T. Murdock and Charles Murdock have been controlling factors. The consideration specified in the petition is $5,400,000, and the Northern Indiana Gas & Electric Company also asks authority to issue ten-year 6 per cent mortgage gold bonds of the company in payment of the entire purchase price. The price for the General Service Company is to be $900,000, and that given for the Indiana Lighting Company is $4,500,000. The two companies that will be taken over by the Geist control, if the commission approves the terms of the merger, will carry with them "all of the gas works, electric and heating works, water-works, buildings, erections and constructions, with the mains, meters, services, poles, wires, generators, engines, boilers, pumps and all other machinery and appliances constituting a part thereof, or used or provided for use in the business of the General Service Company and Indiana Lighting Company of supplying light, heat and power by means of gas to the cities and towns of Crawfordsville, Fort Wayne, Bluffton, Lafayette, West Lafayette, Logansport, Peru, Wabash, Decatur, Lebanon, Frankfort, Ossian, Tocsin, Preble, Rich Valley, Pottawattomie Point, Villa North and Antioch, and supplying light, heat and power by means of electricity to the cities of Lafayette and West Lafayette, and supplying steam and hot-water heating to the city of Lafayette, and supplying water in its natural state to the city of Crawfordsville, all in the State of Indiana."

Real estate in Fort Wayne, Bluffton, Lafayette, Logansport, Peru, Wabash, Decatur, Lebanon, Frankfort, Crawfordsville and "all other real estate wheresoever situate" also follows the purchase, as do all franchise rights, current and liquid assets of the approximate worth of $598,000, and stocks and bonds in the treasuries of the companies carried at their par value in the amount of $3,226,750.

The transfer of the property is subject to obligations and indebtedness, as follows: (a) To the mortgage of the Crawfordsville Water & Gas Company, a total lien indebtedness for bonds certified and delivered, $141,000; (b) to the mortgage of Indiana Lighting Company, bonds issued and outstanding in hands of the public, $2,973,000, and treasury bonds, $1,038,000, or a total of $4,011,000; (c) to current liabilities of both companies, including accrued taxes and interest on bonded indebtedness, $117,000.

History of the Northern Indiana Company

The Northern Indiana Gas & Electric Company was incorporated March 1, 1909, and thereafter took over the following companies: South Bend & Mishawaka Gas Company, Michigan City Gas & Electric Company, South Shore Gas & Electric Company, Indiana Harbor & East Chicago Electric Company, Plymouth Lighting Company, Whiting Electric Light Company and others.

The company now carries on utility business in the following Indiana cities and towns: East Chicago, Hammond, Whiting, Michigan City, South Bend, Mishawaka, Plymouth, Chesterton, Porter, Aetna, Dyer, Griffith, Highland, Munster, Schererville and others.

The capital stock of the company at the present time totals $5,000,000, of which $1,000,000 is preferred stock. The bonded indebtedness of the company consists of $5,739,000 of its own bonds, issued and outstanding, and $3,190,500 of underlying bonds of the subsidiary companies, or a total of $8,929,500.

The bonds which the company seeks to issue in payment for the General Service Company and the Indiana Lighting Company would become secondary to the liens of all mortgages and bonds which now are liens against the Northern Indiana Gas & Electric Company, and also to the mortgages and bonds now a lien against the respective properties held by the companies that would be purchased under the petition.

The petition is signed by C. H. Geist, as president, and G. W. Curran, as secretary, of the purchasing company. Ferdinand Winter and Samuel T. Murdock filed the petition with the commission. The headquarters of the Northern Indiana Gas & Electric Company, which is controlled by the United Gas Improvement Company of Philadelphia, is at Hammond.

Petitions also have been filed by the companies that are to be sold asking approval by the commission of their sale to the Geist company. No date has been set by the commission for a hearing on the proposed merger.

LOS ANGELES CONDEMNATION SUIT

Southern California Edison Company Shows How Its Business Would Suffer if Deprived of Its Los Angeles Load

In the condemnation suit which the city of Los Angeles has brought against the Southern California Edison Company, preliminary reports of which appeared in the ELECTRICAL WORLD for Dec. 4 and Dec. 18, B. F. Pearson, superintendent of the Southern California Edison Company, testified that if Los Angeles franchise rights were lost by the company new transmission lines would be necessary to maintain unity and flexibility in the remainder of the system. Referring to a specially prepared map, he showed that without the Los Angeles business the 47,000-kw. steam plant at Long Beach would not be suitably situated with respect to the center of distribution and would have more than the required capacity.

If the system were to be built anew exclusively for the business outside Los Angeles, he showed that a 13,500-kw. steam plant at Newport would be preferable to the Long Beach plant. The highest peak load on the system, exclusive of Los Angeles business, was 35,000 kw., he said, the maximum peak for the entire system being 56,010 kw.

R. H. Ballard, secretary and assistant general manager, testified that the original company was organized for serving consumers in Los Angeles exclusively, and that, although other business has since been developed, the city business has always been paramount. He pointed out that the original funds for developing the properties were secured, after considerable difficulty, primarily in expectation of increased business in Los Angeles.

In developing business outside the city the primary aim has not been increased volume, he said, but rather a supplementary load that would fit in between the peaks of city demand. Since the maximum city load is coincident with winter lighting, securing a summer pumping load has developed a very high load-factor. The present

investment of $12,000,000 or $13,000,000 in generating and transmission equipment would require to be increased by about one-third were it not for the diversity of load now carried, he stated, which additional investment would, of course, carry the usual interest and depreciation charges.

If the company had not had the Los Angeles lighting load, it could not have made the low rates that have built up outside business. If limited to outside business from now on, he thought it doubtful if the company could keep its rates low enough to retain that business in the face of competition with other companies enjoying the greater diversity of load. He pointed out that in the Long Beach and Kern River No. 1 plants the combined investment of $8,090,000 is $5,990,000 in excess of the cost of a steam plant that would have adequately supplied the load outside the city. The load-factor for the entire system is now 58 per cent, he said; for Los Angeles alone it is 47 per cent, but after complete severance the load-factor would be only 50.9 per cent.

How Company's Earnings Have Grown

He stated that the company's gross earnings had increased from $3,300 in 1896 to $4,427,000 per annum for the electrical department at the present time. The present total generating rating has been found necessary to insure continuity of service for a load curve whose maximum peak is 55,880 kw. An important feature of Mr. Ballard's testimony was a specially prepared chart on which six items were shown graphically from the earliest records of the company up to June 30, 1915, namely, gross earnings, number of kilowatt-hours sold, original cost of physical properties, peak demand, load-factors, and average price at which energy was sold. Beyond June 30, 1915, the curves were continued to show estimated values up to 1923 on two assumptions—first, if the company were deprived of all Los Angeles business, and, second, if it were allowed to retain only the electric-railway load. That is, up to 1915 the chart was historical, and beyond that the values shown were estimated.

If the Los Angeles business were lost, Mr. Ballard testified that the gross earnings would drop from $4,400,000 to $2,300,000 per annum, and that, even assuming the load on the stations would be recovered in eight years, the earnings would then be $700,000 per annum less than at present, owing to decreased efficiency. The 208,000,000 kw.-hr. sold during 1915 would be abruptly reduced by the loss of Los Angeles business to 110,000,000 kw.-hr. per year, he said, and in the eight years following such loss the increase to be expected would raise the total figure to only 178,000,000 kw.-hr. per year.

Under cross-examination, Mr. Ballard testified that the Pacific Electric Railway business was not profitable; in fact, that if it were lost the earnings in the Los Angeles territory would still be 85 to 90 per cent of the present total. He also pointed out that the rates for energy in each district served by the company are based partly on the proportion of the general and administrative expenses of the system charged to that district. Los Angeles should and does bear 45 per cent of the total expenses of this character at the present time. Now, in the event of losing all Los Angeles business save the Pacific Electric Railway load, there would nevertheless be 35 per cent of the total general and administrative expenses still chargeable to this district, which would be, manifestly, operating at very low efficiency. Since this 35 per cent charge could not be made up by increasing the rates, which are fixed by contract, it was only fair, he stated, that the city should compensate the Southern California Edison Company for the loss entailed.

COAL FAMINE FEARED IN THE EAST

Shortage of Cars, the Embargo Placed on Coal by the Railroads and the Possibilities for a General Strike in the Spring Make the Situation Disquieting

Owing to the embargo placed on coal by the railroads and to the shortage of boats needed to transport fuel from Newport News and other Virginia points to the New England and some of the Middle Atlantic States, those sections of the country are facing a serious shortage of bituminous coal. There is a dearth of coal cars due to the fact that many thousands of cars are still unloaded, and besides this the mining districts are short of labor.

Coal is supplied to New York and New England from the Pennsylvania coal fields principally by the Philadelphia & Reading and Pennsylvania Railroads. Most of the coal from West Virginia that is shipped to points in New England goes through Newport News and other Virginia ports.

The shortage of labor in the coal fields is due to the enlargement of many Eastern plants manufacturing munitions and supplies for the Allies. The call for workmen has reduced the number of coal miners in certain Pennsylvania districts nearly 40 per cent, it is estimated. Many of the miners who have quit work are foreigners who have already returned or are hoping soon to go back to the old countries to join the colors.

Coal in Storage

The situation as regards anthracite coal is no better, there being a shortage of buckwheat sizes so widely used for steaming purposes.

The total shipments of anthracite coal for the year to the end of November are 2,459,125 tons behind the first eleven months of 1914. This shortage does not represent by any means the actual falling off in the supply of anthracite for winter use.

The anthracite mining companies have had a thorough realization of what the result of this would be and have maintained production at a rate hardly justified by the markets, putting the surplus into storage until many of the storage yards were filled much above rated or intended capacity. These storage yards are, however, at relatively short distances from the mines and not at points of consumption. In the event of car shortage or of interruption to traffic on the railroads it is just as difficult to get this storage coal to market as it is to get the freshly mined product from the breakers.

The amount of anthracite in storage has been variously estimated at from 5,000,000 to 12,000,000 tons. The latter amount would take care of the markets at a pinch for two months.

Possibilities of Strikes

Many well informed on the coal situation are also apprehensive of a general coal strike in the spring. The agreement between the coal operators and the miners expires on April 1, 1916, and the miners already have presented demands for increased wages and better working conditions. The coal-mining companies have only one union to deal with, the United Mine Workers of America. The treasury of that organization is understood to be in a somewhat depleted condition because of the demands made upon it by the Ohio, West Virginia, British Columbia and Colorado strikes, which were financed by the national organization.

In the anthracite regions the union workers have been carrying on a very active campaign and have recruited the strength of the union, they claim, up to 80 per cent; but this has been only within the last three or four months and has not been sufficient to rehabilitate the treasury. Against this, however, is the fact that quite

a number of alien miners have left the mining regions for the war. This does not seem to have affected the anthracite region as yet, the output for October having been nearly up to the record for any month in the history of the region, and for November it was only a little behind the maximum record for that month. But the ranks are not being recruited at all, and a shortage of labor with a heavy demand for coal is favorable to the union.

A person well informed on anthracite conditions told a representative of the ELECTRICAL WORLD that among the actual workers there is no desire for any prolonged period of idleness. The miners have been receiving good wages and are very prosperous. It is doubtful if many of them will be willing to draw on their own savings if the treasury of the organization should not be able to keep them supplied with funds during a strike of suspension. If a suspension occurs, it is not believed that it will last for more than sixty days.

Government Ownership Justified by United States Forester

The annual report of the forester of the Department of Agriculture, made public Tuesday, comments on the government ownership of water-power sites and timber as exemplified by the national forest system. The financial burdens resting on private owners of uncut timber are held to have forced the manufacture of lumber without regard to market demands and with consequent demoralization of the lumber industry and wasteful use of timber resources, while facts and figures regarding the water-power situation are given to prove that more rapid development of water-power in the West is prevented rather by the lack of consumers than by the absence of suitable legislation.

Water-power permits taken out for national forest projects, says the report, involve a total of 1,251,560 hp. Free permits cover 70,628 hp., and the plants actually constructed or operating on June 30 had an output capacity of 341,276 hp., the rentals paying $89,000 during the year.

The forester's report comments on the water-power situation as follows:

"New legislation permitting the government to grant a more secure tenure for the lands used, through the issuance of fifty-year leases, would without doubt make the financing of power developments on the public lands both easier and cheaper and is very desirable; but the main obstacle to more rapid development than that which is now taking place is not lack of a new law but lack of a broader market for power. It is at least doubtful if either an amended law or private ownership of the public power sites would result in any general or material increase in power development in the Western States in the immediate future. With rare and minor exceptions, existing power developments in these States are far in excess of market demands. The forest service is being constantly importuned to extend periods of construction on power permits, on the plea that there would be no market available for the power if the project were developed. The per capita use of water-power in electrical development in the three Pacific and the eight Mountain States is far in excess of that in any other section of the United States and more than five times the average for the United States as a whole. The development of the Pacific States is about 180 hp. per 1000 population, and in the Mountain States 129 hp., with a balanced average of 160 hp. New England, which is next in order, has less than 40 hp. per 1000 of population, and the whole United States has about 30 hp. per 1000 of population."

Brooklyn Lighting Franchise Upheld

The report of the referee in the suit of the Amsterdam Electric Light, Heat & Power Company and the Edison Electric Illuminating Company of Brooklyn, N. Y., against the Mayor and other city officials to restrain them from interfering with the companies was filed Wednesday with the Supreme Court. The report finds against the Edison company and in favor of the Amsterdam company. Both of the companies, however, are controlled by the Kings County Electric Light & Power Company.

The Kings County company was incorporated in 1890, and four years later it obtained from the Common Council of Brooklyn a perpetual franchise to furnish electric light. In 1898 it purchased the entire capital stock of the Edison company. The latter company was then the owner of all of the bonds and of a large part of the stock of the Amsterdam company, having paid for them $405,000. In acquiring the Amsterdam company the Edison company also acquired all the rights and property of the State Electric Lighting & Power Company, which held a franchise from the Common Council of Brooklyn, given to it on Dec. 30, 1895. In taking over the Amsterdam company the Edison company got 4878 shares of its total of 5000 shares. Last year the Public Service Commission permitted the Edison company to purchase the remaining twenty-two shares.

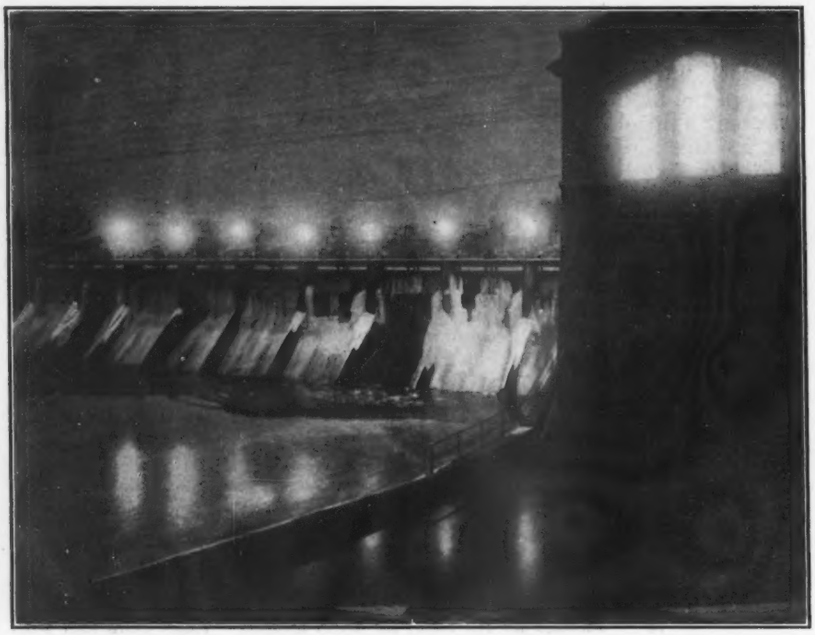
The anxiety of the two plaintiff companies grew out of the activity of the division of franchises of the Board of Estimate, which recommended the passage of a resolution for the revocation of the franchise granted to the State company in 1895, which had passed to the Amsterdam company, then to the Edison company, and then under the control of the Kings County company. Fearing that an attempt would be made to revoke this franchise, the injunction proceedings were begun.

The city held that the franchise had been forfeited by the failure of the Amsterdam company to comply with its terms and provisions, but the referee does not find that the company is liable on this ground.

"The conclusion at which I have arrived," the referee adds, "is that the complaint should be dismissed as to the plaintiff Edison Electric Illuminating Company of Brooklyn, and that the plaintiff Amsterdam Electric Light, Heat & Power Company is entitled to an injunction restraining the defendants from passing any resolution purporting to revoke the resolution of Dec. 30, 1895, or to forfeit the rights of said plaintiff thereunder, or to prosecute the bond given in pursuance of said resolution. Findings agreeing with this opinion may be submitted."

Report-Writing for Engineering Students

What is probably the first course in report writing ever inaugurated in an engineering school was launched last fall at the Massachusetts Institute of Technology in the curriculum of the course in engineering administration. About eighty students are receiving instruction in this special branch. The course has been planned to improve a general weakness of engineers in the direction of both popular and semi-technical written expression. It includes practical investigations of topics of engineering interest, such as the fitness of motor-operated fare registers in the Boston subway stations, the feasibility of starting an auto-truck sight-seeing enterprise, the practicability of establishing a dye-manufacturing plant, the wisdom of equipping the new buildings of the institute at Cambridge with an electrically operated blueprinting outfit, and other semi-technical and industrial questions. The course is under the direction of William Green of the English department.



Features of Barton Station

Among the unusual features of this station are: (1) The high ratio of turbine rating to average river flow; (2) the method of compensating for rise in tailwater level during flood seasons; (3) facilities for emptying the wheel pits quickly for inspection or repair; (4) scroll-case design to minimize the wheel-approach velocity of the water; (5) construction to prevent formation of anchor ice; (6) provisions to allow control of all equipment from the switchboard; (7) arrangement to utilize the force of gravity in circulating cooling water through the transformers, and (8) convenient location of thrust bearings. Elaborate facilities are provided for interior illumination and spectacular lighting of the dam crest and water sheet passing over it. The decorative illumination of the dam can be seen from passing New York-Chicago trains, which cross the river just below the plant, and it also serves as an indication of danger to the hundreds of canoeists who paddle on the pond above the dam. The construction cost per installed horsepower of main turbines was $98.20, or $135 per kw. of generating equipment.

Hydroelectric Station Auxiliary to Steam Plant

One of Four Plants on Same River Connected to System of Eastern Michigan Edison Company, Which Is Also Fed by Delray and Conners Creek Steam Stations of Detroit Edison Company

BY RAY K. HOLLAND*

THE Barton water-power plant of the Eastern Michigan Edison Company, near the city of Ann Arbor, Mich., is one of a series of low-head power plants contemplated by this company along the Huron River. The ultimate development will probably include nine similar plants varying in head from 14 ft. to 32 ft. and utilizing a total fall of about 215 ft. The power of the river has been used to drive flour and pulp mills since the early part of the last century, and present developments in some instances utilize parts of the old structures, such as old rock-fill dams, head-race embankments and heavy cut-stone walls. The Barton plant is an example of a new structure built at the site of an old feed mill which was one of the industries of the hamlet of Barton as early as 1835.

The plant has a turbine rating nearly twice the average annual or equalized flow of the river, notwithstanding the fact that there is no artificial storage of flood waters above the site. This large turbine rating is warranted in this case because the Eastern Michigan Edison Company operates one steam and four hydraulic generating stations and is connected by duplicate transmission lines with the large steam stations of the Detroit Edison Company. The relatively small total rating of all the generating plants of the Eastern Michigan Edison Company in comparison with the Delray and Conners Creek steam plants of the Detroit Edison Company allows the hydraulic stations to contribute power to the system at such times and in such amounts as they are able to produce at their best efficiency. The result is that water is wasted over the spillway of the Barton dam only in times of considerable floods, which last during an average year less than two weeks. In other words, excess machine capacity, in conjunction with a large distribution system, has made possible an economical water utilization that is sometimes accomplished by extensive storage reservoirs in the headwaters.

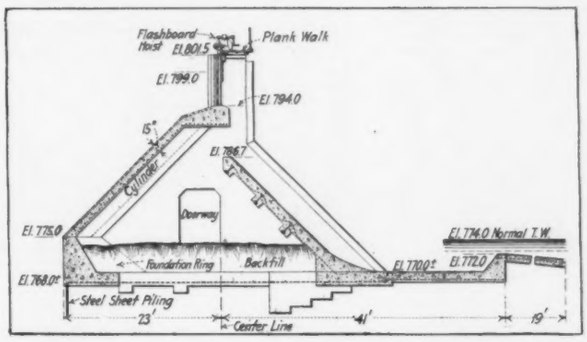
*Electrical engineer with Gardner S. Williams, consulting engineer, Ann Arbor, Mich.

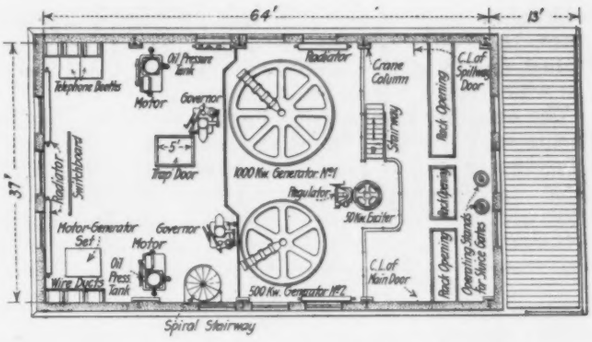
Power House and Equipment

A longitudinal section of the power house is shown in Fig. 6. The building is of reinforced concrete up to the generator-floor line, with yellow paving blocks above. The roof is of green tile laid on wooden matched sheeting covered with tar paper. All windows have steel sash with a ventilating section.

The building houses two main units, one a 68-in. turbine directly connected to a 1000-kw. generator, the other a 57½-in. turbine directly connected to a 500-kw. generator. Units of different sizes rather than two alike were installed to increase the plant efficiency. Thus high efficiency is had over a range of load from 250 kw. to 1500 kw. Between the two main units transversely, and up-stream from them, is the exciter unit, which consists of a 16-in. turbine and a 50-kw. exciter. All three are vertical units, the turbines being set in open-scroll-case wheel pits similar to those first used by Gardner S. Williams at the plant of the Edison Sault Electric Company, Sault Ste. Marie, Mich., in 1904. The larger wheel pit is 16 ft. 3 in. and the smaller 10 ft. 3 in. wide, dimensions which keep the approach velocities down to about 2 ft. per second at maximum capacity.

To give access to the turbines, wheel-pit gates are provided under a platform outside the up-stream end of the power-house superstructure. These consist of a pair of swinging doors, hinged to the wheel-pit walls so as to close against a vertical beam in the center of the opening. The wheel pits were designed to permit the closing of the gates under the condition of full-gate opening on the turbine, and the wisdom of this was demonstrated soon after beginning operation, when a block of wood lodged in the turbine gate and prevented





FIGS. 2 AND 3—CONSTRUCTION OF MULTIPLE-ARCH DAM AND ARRANGEMENT OF GENERATORS, EXCITERS, OIL GOVERNORS AND CONTROL APPARATUS

its closing. The operator with the help of the relief operator closed the wheel-pit gates, emptied the wheel pit, removed the block, refilled the wheel pit, and opened the wheel-pit gates ready for the turbine operation in about fifteen minutes. The ease of operation of the gates is a very large factor in keeping the turbines up to their best operating condition, as emptying the wheel pit is almost as simple an operation as starting and stopping the unit.

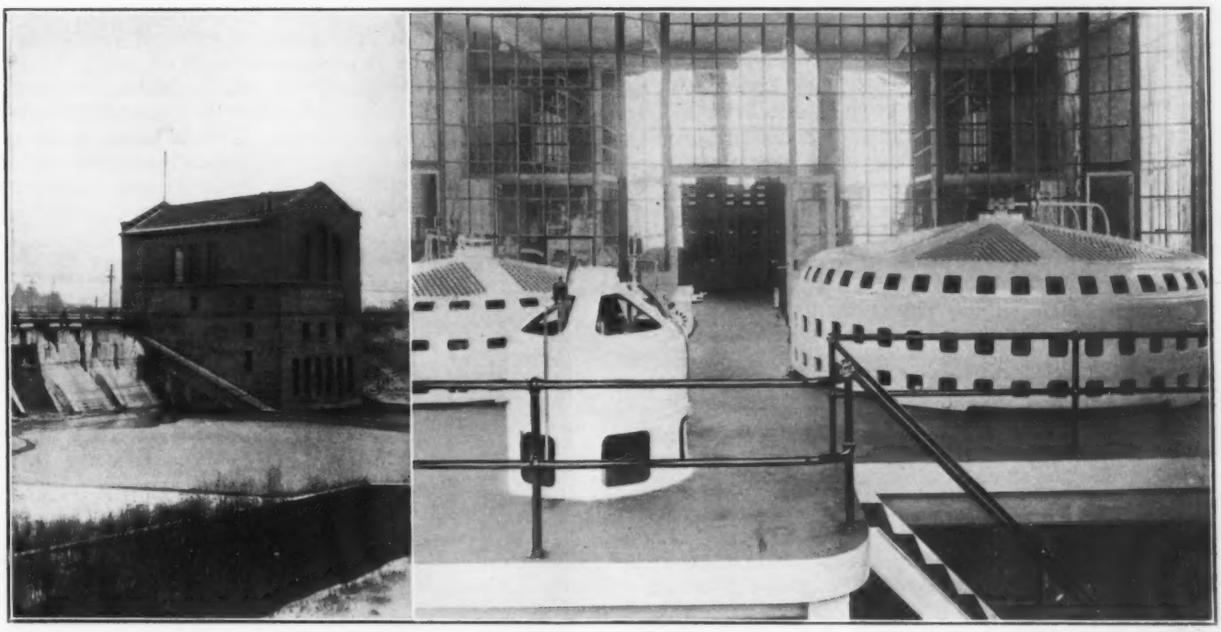
The turbines are set over concrete draft tubes which discharge the water into the tailrace at a velocity of about 3 ft. per second. An opening in the basement floor allows stop logs to be put down across the mouth of the draft tubes so that they can be emptied should occasion arise. The exciter draft tube empties into the draft tube of the larger unit just above the bend. Provision was made at the time the plant was built to allow the insertion of a Pitot tube at different points in the draft tube to determine the distribution of velocities, but as yet no work has been done along that line.

Among the unusual features of the power house are the two sluices which take water from the pond upstream from the turbines and discharge it into the draft tubes. During the period of construction these sluices were used to carry the low-water flow of the river, and in the completed structure they afford a means of readily lowering the pond whenever desirable. Each sluice is controlled by a cast-iron sluicegate operated from the thrust-bearing floor. During the flood season of the year the sluices are also used to assist in regulating the pond level, and the discharging of the water into the draft tubes results in an increase of the power output of the turbines, compensating in a large measure for the decreased output due to rise of the tailwater level.

Transmission and Switching Arrangements

The generator voltage is 2300, and it is stepped up to 23,000 volts for transmission. Both high-tension and low-tension switches are installed in the switch room directly below the switchboard and are manually controlled from the board. The switch room has a clear height of 16 ft. and occupies the down-stream third of the structure immediately below the generator floor and behind the wheel pits. Here are also the house-service transformers and main house-distribution panel.

Below the switch room is the transformer room, containing two banks of oil-cooled 2300/23,000-volt, sixty-cycle transformers of 1000-kw. and 600-kw. rating each. The window openings in this room are the full height of the room and are closed with galvanized-steel louvers



FIGS. 4 AND 5—EXTERIOR OF PLANT AND INTERIOR OF GENERATOR AND CONTROL ROOMS

The glass partition between the generator and control rooms permits the station operator to see all of the generating equipment and still separates the two rooms so that only the latter need be heated in cold weather. The stairway in the foreground affords convenient access to the thrust-bearing floor and wheel-pit-gate and sluicegate mechanisms. From the thrust-bearing floor an exit opens onto the dam-crest walkway, from which the flashboard hoists can be operated.

with steel inside doors. On this floor, in a separate room, the boiler for the steam-heating system is installed, and immediately above the latter there is a coal bin which is filled from the outside.

The outgoing transmission lines pass, in brick ducts in the wall on each side of the building, up from the transformer room through the switches in the switch room and through the generator room to roof insulators. Connected to these lines are 23,000-volt, four-tank aluminum-cell lightning arresters, which stand on concrete platforms just above each end of the switchboard. Serv-

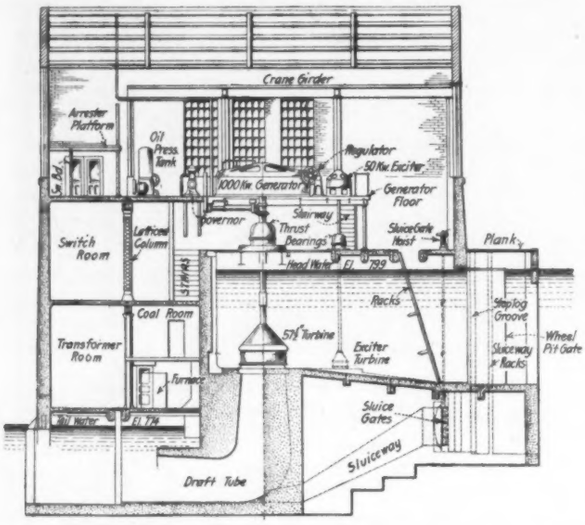


FIG. 6—RELATIVE POSITIONS OF GENERATORS, TURBINES, SWITCHES AND TRANSFORMERS

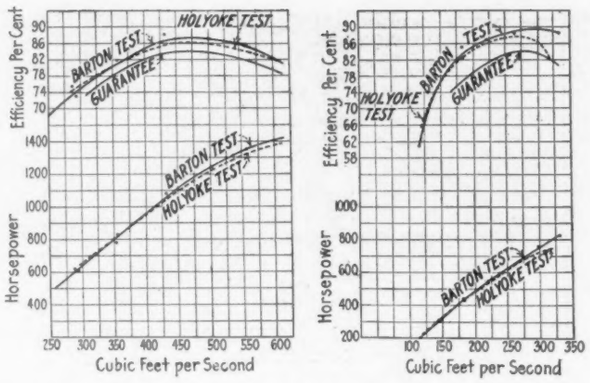
The position chosen for the thrust bearings eliminated the need of heavy spiders on the upper sides of the generators and afforded a desirable support for both generator and turbine shafts. As shown by the drawing, the transformer room is below the head-water elevation, so that cooling water can be forced through the transformers by gravity.

ice for lighting the operators' houses and yards is supplied through an underground cable from the switch room to the first transmission pole.

Efficiency Tests

The results of a complete efficiency test made upon this plant in July, 1915, are shown in the curves of Figs. 7 and 8. The contract stipulated that the turbine manufacturers should pay a forfeit for an average efficiency below the guarantee for a range between half and full discharge, and that the company should pay a bonus for an average efficiency above the performance, over the same range, of the type model in the Holyoke test. The results of the tests as shown on the curves indicate that the company must pay a bonus to the turbine manufacturer.

The head on the wheels during the test was measured from the surface of the water inside the wheel pits and down-stream from the racks to the surface of the water in the tailrace at the outlet of the draft tubes. The power output was measured by calibrated wattmeters using certified shop tests of the generator units for calculating the generator losses. The water was measured by a standard sharp-crested weir without end contractions placed in the tailrace. The water above the weir communicated with gage wells at each side of the tailrace through a 6-in. by 6-in. concrete chamber extending underneath its bottom parallel to the weir and 16 ft. up-stream. Orifices in its top, 2 in. in diameter and flush with the channel bottom, connected this chamber with the water approaching the weir. Hook gages were used to measure the elevation of the water in the



FIGS. 7 AND 8—COMPARISONS OF PLANT AND HOLYOKE TESTS OF THE 1000-KW. AND 500-KW. WATER TURBINES

wells, the crest reading being established by water leveling. The discharge was computed by means of Bazin's formula.

The quantity of water discharged by the sluices was measured, and a test was made of the effect of discharging water into the draft tube of the smaller unit while it was running at six-tenths gate. It was found that the power of the turbine was increased about 9 per cent or that the effect of an 18-in. rise of tailwater would be compensated. The quantity of water passed by turbine and sluice together was equal to the sum of the quantities discharged by each separately.

Operators' Houses

The policy of the Eastern Michigan Edison Company is to house the plant operators comfortably. Two houses were originally constructed, and a third is being added at the present time. These houses are situated across the pond above the dam. Each has six rooms with bath, running hot and cold water, furnace heat, electric lights, sanitary sewer connection and cistern for rain water. They are of frame construction, with stucco finish and cypress trim outside, and have hard-wood floors inside. Outside hose connections and lawn hose are supplied, and the operators take a great deal of pride in keeping their lawns and the plant grounds so that they resemble a park.

The plant was designed and its construction was supervised by Gardner S. Williams, consulting engineer of Ann Arbor and Chicago. The electrical equipment was furnished by the General Electric Company and the hydraulic machinery by the Allis-Chalmers Manufacturing Company of Milwaukee, Wis.

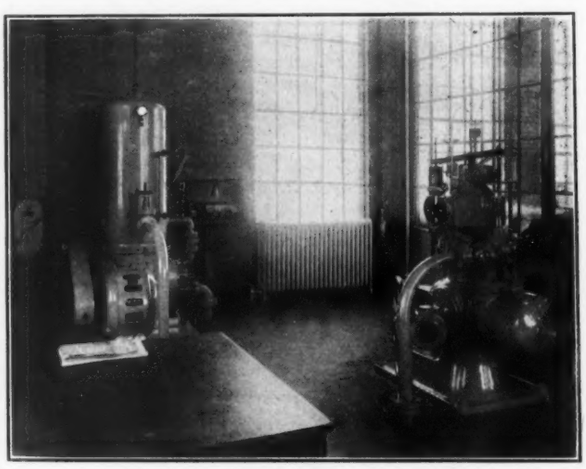
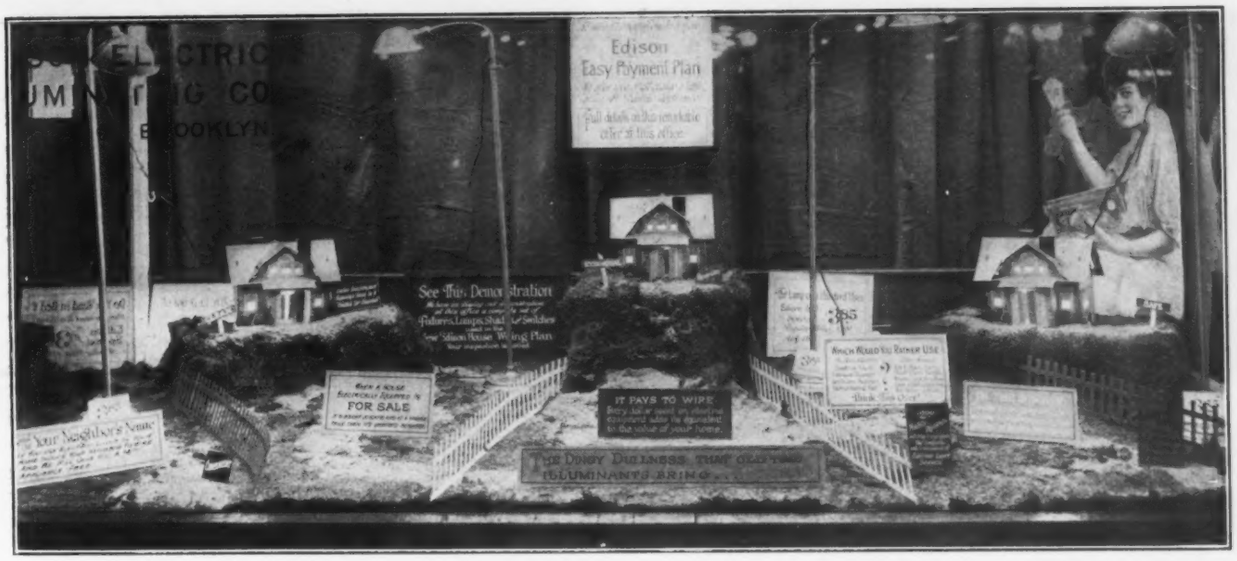


FIG. 9—OIL-PRESSURE APPARATUS AND 1000-KW. TURBINE GOVERNOR



A CLEVER WINDOW DISPLAY THAT FEATURED THE "EDISON EASY-PAYMENT PLAN" IN BROOKLYN. EVERY EFFORT IS MADE TO ASSIST THE CUSTOMER TO UTILIZE ELECTRIC SERVICE AS COMPLETELY AS HE CAN

The Power of Easy Payment in Appliance Sales

BY EARL E. WHITEHORNE

There was a period—and not so many years ago—when the policy of selling goods on so-called "easy payments" was strictly on probation in the electrical industry. It was a new idea among us, and when managers met at annual conventions we heard the question often, "Do you believe in easy payments?" But the day for that is over now. The thing for every man to ask himself to-day is this: "Which shall I do—branch out into this great big undeveloped field of opportunity or plug along in the old accepted way and turn my back on all the lessons of the interesting experience of so many central stations, manufacturers and dealers?" The principle has been established. The policy has been well proved. It is time to lay all inherited prejudices aside and weigh the matter on a simple basis of business expediency.

IF you could go to-day before 500 of the livest central-station managers in the country and should ask all those who don't believe in "easy payments" to stand up, what do you think would happen? A big majority would climb up on their feet and register against it—and yet, if you should ask their reasons one by one, you would find about two answers and no more. A few would tell you stories that would show a trial foreordained to failure because the principle was unintelligently applied and because the proposition was inadequately presented and worse handled. But the rest would say they don't believe in it because—well, just "because"—because they are prejudiced against it and have never tried it or had eagerness enough really to find out what experience in other cities has developed. Yet those other men who held their seats could tell them stories and cite figures that would settle every reasonable doubt.

New to Us, but Old to Others

The principle of installment payments is still new to us perhaps, but it is old and well established in the big broad world of retail business. Pianos have been sold that way for years. Cash registers are sold that way. Good books are sold that way. And so is furniture and real estate, and so are typewriters and phonographs, electric washing machines and vacuum cleaners, and so are other things that cost too much for most of us to buy conveniently for cash or ordinary credit. This generation has adopted this arrangement to facilitate the purchase of those luxuries and comforts that our grandfathers would have continually sacrificed for fear of debt. We want them, and we consider that our families are entitled to them if a way can be found to buy them without risk or worry, and so the "easy-payment" plan has been devised and universally accepted as a proper and commendable expedient.

This is the way it strikes us individually, but as an industry we face it from the other angle.

"Here are these goods," we say. "They cost a lot of money, and it's hard to sell them outright to the average home. Now, what has been the experience of other manufacturers and merchants in such situations?" And we find that other industries have most successfully adopted the easy-payment plan, and there is our answer. Again, on looking deeper we discover that this plan is better suited to the central station than to any other business that employs it, for the central station is already well equipped with full machinery for collecting monthly payments, because easy payments just become an added item on the bill—and there you are! There is no reason why the central station should not do it, but there is prejudice against it, and such prejudice dies hard.

A Few Notable Examples

In Pittsburgh, for instance, the Duquesne Light Company did not believe in easy payments and sold electric washing machines for years for cash. It never averaged better than ten or twelve sales a month in all its territory. Then it offered these machines on a basis of 20 per cent, or $18, cash down, and right away its sales

THE WINDOW IS ALWAYS A POWERFUL INFLUENCE IN GIVING PUBLICITY TO AN EASY-PAYMENT OFFER

increased to an average of twenty a month. It cut the price to $10 down, and sales increased again to thirty a month. Again it reduced the amount of the initial payment to $5, and the monthly average ran right up to over sixty, and the company is confident that with a little harder pushing it can reach a scale of 75 to 100 machines sold every thirty days. In the month of October this company sold 275 vacuum cleaners of one make alone, this being the machine it featured on an easy-payment proposition.

In Cleveland a prominent dealer sold about six washing machines a month until quite recently an installment offer was made. Already sales have jumped up to thirty or forty a month, and as soon as the campaign develops further this city should be good for a greatly increased output.

Again, in Bloomington, Ill., a good example of a smaller town of 25,000 people, the central station formerly was selling only about ten machines a year until it offered easy payments with $10 as the cash down with the order. In a very short time the average was raised to about ten sales each month, twelve times as much as had been done before, with no more work.

There are unlimited examples of just such experience. I talked the other afternoon with one of the biggest manufacturers of washing machines, and he reeled the cases off too fast to make notes of, though there would be small point in such repetition here. For the thought I want to make is this: that the whole thing boils right down to principle and policy and prejudice. There is no use in citing figures to a man whose prejudice refuses to believe that such good evidence applies to him; and anyone who thoughtfully will turn the matter over in his mind and see the facts and what they offer him can find at hand a wealth of data ready for his use and all the personal testimony he could wish in confirmation. No man who takes the trouble to inquire and consider can question for one moment in his own mind that the easy-payment plan sells big appliances a hundred times more quickly than the old ways. It has been proved so clearly by so many companies which he knows are just as wise as he is in the operating of a central station that it is no longer a matter for argument where the facts are recognized. His "local conditions" cannot be so "different" that among the many companies large and small where big results have been achieved by easy-payment selling there is not a clear case of appropriate example to guide him. The whole thing simmers down to a simple matter of attitude. Are you willing to adopt a new plan of progressive merchandising in order tremendously to increase your sales, not only of ranges, fireless cookers, washing machines and vacuum cleaners, but of all appliances? For if the principle is good for one it is certainly good for all. Or are you "agin it" just because it is new and strange to you and sounds like trouble?

Why We Need the Easy Payment

"Why should it be necessary?" asks Mr. Skeptic. But as individuals you know just as well as I do. As this manufacturer expressed it: "People can't afford to put down $100 in cash to buy a high-priced washing machine, no matter how much money they have. A woman usually has an allowance for running the house, but she can't squeeze that much money out of any one month's allowance, so she must buy by installments or not at all. We have people who we know could buy out our whole company come in and purchase on the easy plan. Then take the fellow who earns $125 a month—he can't afford to pay down $25 or $50 for a household labor-saving appliance, no matter how much he wants it. He is glad to buy on small payments, however, and his account is

THE "HIGH SPOT" IN ANOTHER EASY-PAYMENT ELECTRIC-WASHER CAMPAIGN. THE SLOGAN WAS, "TEN DOLLARS A MONTH BUYS A THOR"

just as good on your books as Rockefeller's; and, after all, these are the people who buy the bulk of the machines. It is the man whose wife is doing her own work, or the household with one overloaded servant, that you must adapt your proposition to."

In other words, the people are anxious to buy. Are you willing to meet them half way?

The greatest obstacle to the general immediate adoption of the easy-payment plan, the manufacturers say, is difficulty in convincing the "man higher up." The central-station salesman is "for it," for he knows that it will open up a wonderful amount of business. The commercial manager is not slow to appreciate the opportunity. Yet upstairs sits the Big Chief, and too often the Big Chief says: "I don't mind carrying a good customer if he needs accommodation in the buying of a range. If he comes in and asks for it, we'll sell him on the installment plan, but I don't think we want to advertise broadcast." Yet the salesman knows that the public won't come asking easy payment as a favor. Natural pride won't let it. The central station must either offer easy payment as a special inducement free to all or just give up the thought of doing any worth-while business in the big appliances.

Why should you fear to advertise this policy? Your bookkeepers are making bills out every month to every customer. Another item on the bill adds no appreciable expense to you per bill. Your bills are sent out regularly to every customer. Your regular collectors are available to bring the money in just as they do at present. You are equipped and ready to take on this easy-payment business with a minimum of cost and trouble. To cover cost you can add an item of 5 per cent to the selling price. (This 5 per cent you can offer as a cash discount too.) Keep the title to the appliance till the final payment is made and you are perfectly secure. For there are ample facts to prove all this. One company, for instance, that now has $80,000 on its books in these accounts finds that it averages less than five appliances taken back each month because of failure to pay, and most of these are soon restored again. Moreover, if manufacturers can sell on easy payments, and if local dealers can make money at it, why should central stations hesitate when really it means just a slight extension in the present scheme of doing business? For it is but a short step from selling energy by the month and selling energy-consuming appliances to the same good customers on the same safe plan.

The Broader Aspect

Some men hang back and say: "Why bother with the washing machine? It brings only an income of about 25 cents a month." I am not talking about one washing machine. I am thinking about the thousand washing machines that you can sell between now and this day next year—and all the suction sweepers and the percolators and the toasters and the rest of the appliances that you can market just as soon as you will make it easy for the public to acquire them. A single washing machine may mean but 25 cents a month, but a thousand of them will bring you an annual income close to $3,000, and that's the way to calculate the power of the easy payment. How many of the gas ranges that are gayly cooking dinners in your town right now would have remained unsold if the people could not have bought by easy payments?

It is time for every central-station manager who has not tried the selling power of the easy payment to rub his eyes and look about him. Is he working day by day just to perpetuate a set of traditional policies, or is he striving to manufacture needed income for his stockholders, to "make good" on the capital he operates for them in trust? There is no place for personal prejudices in a matter so important in its possibilities. There is no excuse for any central-station manager who deliberately refuses to admit that easy payments pay. And if he does admit it, there remains just one thing for him to do.

Cable Suitable for Industrial Plant Subway System

A Comparison of Rubber, Cambric and Paper Insulation and the Current-Carrying Capacity of Cables When Used in an Underground Duct System

BY H. D. AUSTIN

ENGINEERING considerations in connection with the design and installation of a subway system for the distribution of energy to a group of factory buildings were presented in the Dec. 4 issue of the ELECTRICAL WORLD. In what follows the characteristics of cable suitable for use are taken up. Cables are the vitals of an underground-duct system, and as much attention should be given to their selection and installation as to the installation of the duct system itself. Local conditions govern the selection of cables to some extent since certain types of cable are better suited than others to resist extreme wet conditions and electrolysis. Again, the design and construction of cables is a consideration of importance. Not only can a number of substances in varying proportions be used for the insulating walls, but also the oils and methods of impregnation can vary within a wide range for both cambric and paper insulations.

In recent years considerable advance has been made in the manufacture of lead-sheathed cables for underground service. Among the shapes of cable conductor sections which are available are the solid or stranded round conductor, the concentric-conductor cable and other multiple-conductor cables having the conductors laid in a sector-shaped section. The two latter types, the concentric conductor and the sector-shaped conductor cable, are so designed as to give a maximum copper section and reduce the insulating material to the minimum required. Such cables permit of a maximum ampere capacity per duct and can often be used to advantage where additional current-carrying capacity is required and the duct capacity limited. The concentric-conductor cable is generally used for secondary distribution where a large current-carrying capacity is required in a two-conductor cable. The sector-shaped conductor cable is usually a triple-conductor cable and may be used for either primary or secondary distribution, but, as already stated, it is especially suited for distributing large currents at a low potential.

The three mediums now in common use for insulating power cables are rubber, cambric and paper. The characteristics of each of these insulating materials will be described briefly, giving the service for which each is best adapted.

Comparison of Insulating Mediums

Rubber.—Para rubber, when carefully compounded and applied, has proved itself most suitable for general service. Rubber insulation possesses great dielectric strength and also is very elastic. It will therefore resist a stretching or bending treatment which would ruin either cambric or paper insulation. Also, rubber is unaffected by pure water—that is, water containing no acids, oils or other destructive agencies. This is a very valuable characteristic, especially where cables are continually exposed to water in wet subway systems. On the other hand, an inferior insulation is produced if the rubber is not scientifically and carefully compounded. Rubber insulation also has the disadvantage that it cannot be heated above a certain safe temperature without injury. This insulation is superior to either paper or cambric for small wires and thin insulating walls. It is especially suitable for use in cool, wet subways where ample copper is used in the conductors and the heating is moderate.

Cambric.—Cambric insulation is proving itself very satisfactory in service, especially for large conductors and for high-voltage cables. This insulation is formed by winding varnished cotton or muslin fabric spirally in tightly drawn layers about the conductors, the layers being held together with a thin layer of plastic compound. The dielectric strength of varnished cloth is very high. The plastic compound not only prevents the varnished tape from unwrapping, but also gives the cable a degree of flexibility and permits it to be bent without straining the insulating walls. The plastic compound prevents absorption of moisture between layers of tape and seals all pinholes in the tape wrappings. A varnished-cambric cable can only be bent to a radius equal to six times its own diameter. Varnished-cambric insulation is, therefore, not well suited for small-size wires and thin insulating walls. As regards its moisture-resisting properties, cambric insulation is second to rubber but has been found superior to saturated paper.

Varnished-cambric insulation will furnish a large, safe current-carrying capacity for any underground electrical conductor, even when the conductor itself is large and its heat radiation low, provided that extreme wet or electrolytic conditions do not obtain in the subway.

Paper.—Saturated-paper insulation for underground subway cables is also being used quite extensively at the present time. This insulation is applied to the conductor in narrow strips spirally wound until the desired dielectric strength is attained, after which the insulation is thoroughly impregnated with a moisture-repelling compound. Insulation made from pure manila-rope paper impregnates uniformly and does not "felt down" as do the papers made from combinations of manila fiber, wood pulp and jute. The dielectric value of paper depends not only upon the quality of paper used but also to a great extent upon the composition and fluidity of the insulating compound.

Paper insulation is strong and uniform in quality, but less flexible than cambric. A paper-insulated cable can only be bent to a radius of eight times its own diameter. Paper cables are generally cheaper than either rubber or cambric and can be worked safely at a higher temperature. On the other hand, paper insulation is susceptible to moisture, and its useful life is practically determined by the integrity of the containing lead sheath. The lead sheath for paper-insulated cables must therefore be made somewhat thicker than for either rubber or varnished-cambric cables. Paper cables can be used to advantage in any underground subway that is reasonably dry and free from conditions favorable to electrolysis.

In the selection of insulated lead-sheathed cables for any subway system the local conditions are the governing feature. The amount of water present, the degree of electrolytic action that may be expected, the temperatures encountered, the range of safe current-carrying capacity desired, and the flexibility required in the cables themselves will in general determine the kind of insulation best suited to meet the local requirements.

Current-Carrying Capacity of the Different Kinds of Cable

For safe current-carrying capacity of rubber, cambric and paper cables the accompanying tabulated values, compiled by the General Electric Company, are recommended as a guide for actual service. Actual service conditions, such as the initial temperature of different subway systems and their heat-radiating properties, vary widely. This table as given is based on an initial temperature of 20 deg. C., and allows a maximum temperature of 50 deg. C. for rubber and 80 deg. C. for varnished-cloth and paper insulations.

Rubber insulation is a better heat conductor than either varnished cambric or saturated paper, but it should not be worked above $60 - E/4$ deg. C., where E is the root-mean-square working emf. in kilovolts. Varnished cambric is likewise a slightly better conductor of heat than saturated paper, but owing to the slightly higher temperature at which paper can be worked, the safe current-carrying capacity of cambric and paper insulations is about equal.

CURRENT-CARRYING CAPACITY OF RUBBER, CAMBRIC, AND PAPER CABLES—INITIAL TEMPERATURE, 20 DEG. C.

Size of Cable in Circ. Mils	Single-Conductor Cable		Three-Conductor Cable
	Rubber, 30 Deg. C. Rise, Amp.	Varnished Cambric or Paper, 60 Deg. C. Rise, Amp.	Rubber and Varnished Cambric, 30 Deg. C. Rise; Paper, 35 Deg. C. Rise, Amp. per Conductor
2,000,000	1,400	1,750	.....
1,500,000	1,200	1,500	.....
1,000,000	900	1,150	.....
750,000	750	900	.....
500,000	550	660	440
400,000	460	560	360
300,000	370	450	290
250,000	320	390	250
200,000	270	310	210
150,000	220	260	175
125,000	180	210	140
100,000	160	190	125
80,000	140	165	110
60,000	110	130	85
40,000	75	90	60
No. 6 B. & S. solid	50	60	40

When using the table for concentric two-conductor cables, it is advisable to take as the safe current capacity 20 per cent less current than given in the table for the same size of single-conductor cable. For four-conductor cables it is advisable to use 10 per cent less current than given for same size of triple conductor.

Specifications for Cable

Specifications for wires and cables have been issued by the Association of Railway Electrical Engineers, American Electric Railway (Engineering) Association, American Society for Testing Materials, Joint Rubber Insulation Committee, National Fire Protection Association and other representative bodies. The standardization rules of the American Institute of Electrical Engineers also contain considerable information on cables. Unless special conditions dictate otherwise, the engineer cannot do better than to avail himself of these recommendations when drafting cable specifications.

Establishing a Basis for Laws on Lighting

BY C. E. CLEWELL

Legislation providing for definite standards in the workman's environment has included a consideration of what constitutes suitable lighting. If these standards are to be equitably established, a background of expert opinion is needed. Mr. Clewell in an article printed in the ELECTRICAL WORLD *for Nov. 20, page 1135, reviewed the recently issued factory Code of Lighting of the American Illuminating Engineering Society. Both the American and the British code have a particular interest not only to illuminating engineers but to all those concerned with better lighting, and particularly with statutory provisions for better lighting.*—Editor's Note.

THE appearance of the first report of the departmental committee on lighting in factories and workshops under the direction of the Home Office of the British Parliament almost simultaneously with the "Code of Lighting for Factories, Mills and Other Workplaces" in the United States, under the supervision of committees of the Illuminating Engineering Society, is of unusual interest when it is considered that in each case these committees have been at work for several years in a systematic effort to establish standards in this particular field. The British report consists of a document of ninety-one pages, three of which cover a memorandum concerning the report, nineteen are devoted to the report proper including the specific recommendations of the committee, while the remaining sixty-seven include seventeen appendixes of valuable data based on the exhaustive researches of the committee into actual factory lighting conditions in eighty-five factories throughout Great Britain.

The memorandum accompanying the report proper is dated August, 1915, and emphasizes the purpose for which the present committee was appointed—"to inquire and report as to the conditions necessary for the adequate and suitable lighting (natural and artificial) of factories and workshops, having regard to the nature of the work carried on, the protection of the eyesight of the persons employed, and the various forms of illumination." Reference is made to existing legislation of factories and schools in certain foreign countries as of Sept. 30, 1913, and a most valuable summary of this legislation is included for Austria, Belgium, Denmark, France, Germany, Holland, Italy, Norway, Sweden and the United States of America. The statement is frankly made that for Great Britain no general provisions in regard to lighting (analogous to those regarding heating and ventilation) occur in the factory acts, although "adequate" lighting in general terms is included among the conditions to be satisfied in underground bakehouses and is required in certain dangerous trades.

Extent of Observations

It is pointed out, therefore, that the appointment of the committee in regard to industrial lighting marks an entirely new departure and that the nature of the inquiry undertaken to establish the necessary conditions for proper lighting involved special and far-reaching methods of investigation. To limit the inquiry to a practical basis, it covered, in this first instance, in the main only engineering, textile and clothing trades. The evidence on which the conclusions were drawn up was determined from fifty witnesses, including government factory inspectors and representatives of trade associations and scientific and technical societies. About 4000 measurements were made of illumination in 163 rooms of fifty-seven factories. These observations were usually taken prior to the visit of the committee members so that quantitative ideas could be formed in advance.

Four points stand out with particular prominence in this inquiry: First, the conclusion, based on actual statistics, that inadequate lighting is a contributory cause of accidents; second, the general impression that unsatisfactory lighting is, in various ways, prejudicial to health; third, that insufficient light adds to the difficulty of the proper supervision of work and of the maintenance of cleanliness and sanitary conditions generally, and, fourth, the actual evidence from witnesses to the effect that improved lighting can be productive in increasing the output and improving the quality of work turned out. These four main conclusions of the committee form an excellent summary of the most important phases of the lighting situation in relation to the industries.

The item, however, of perhaps the greatest interest in the entire report is that of the recommendations made by the committee after its two years' work of investigation. In the memorandum the committee makes the following statement:

Recommendations of Committee

"From the evidence taken it is apparent that there is a general consensus of opinion as to the economic and hygienic advantages of adequate and suitable lighting. That this opinion is based on experience is shown by the great improvement in lighting which has taken place during recent years and is still continuing, and in modern factories good lighting is now regarded as one of the most important factors contributing to industrial efficiency. On the other hand, many employers have lagged behind in the general advance. This refers especially to old factories, and it is obvious that any requirement which would tend to bring such places up to the level of more progressive firms would be beneficial not only to the operative by improving his working conditions but also to the employer himself by increasing his output and by improving the quality of work. Light is a cheap commodity, and little or no hardship should result from such a requirement if gradually and sympathetically enforced."

Preliminary to the treatment of the question of the actual quantity of illumination for specific purposes, the committee makes the recommendation that there shall be a statutory provision (a) requiring adequate and suitable lighting in general terms in every part of a factory or workshop, and (b) giving power to the Secretary of State to make orders defining adequate and suitable illumination for factories and workshops or for any parts thereof or for any processes carried on therein.

There are included in this connection two defining statements covering the meaning of the term "adequate lighting." The illumination is said to be adequate and suitable if (1) it is sufficient for the proper carrying out of the work both as regards quantity and output, and (2) there are no lighting conditions prejudicial to the health, comfort and safety of workers.

The committee has taken the stand that these require-

ments are satisfied provided that the illumination complies with the following specifications: (a) adequacy; (b) a reasonable degree of constancy and uniformity of illumination over the necessary area of work; (c) the placing or shading of lamps so that the light from them does not fall directly in the eyes of an operator when engaged on his work or when looking horizontally across the workroom; (d) the placing of lights so as to avoid the casting of extraneous shadows on the work.

Concerning the wisdom of specifying the amount of illumination included by the rather general terms "adequate" and "suitable," the committee seems to feel called upon to make several more or less provisional statements. Attention is called first to the progress made recently in devices for measuring illumination. On this point the committee takes the stand that a specification of numerical values is now practicable in a far greater degree than could have been hoped for several years ago. The proposition is then made that a minimum desirable illumination intensity should be specified from the standpoint of general convenience and safety in those parts of working spaces where work is normally conducted and also in yards, passages and open spaces along which persons are ordinarily liable to pass.

Specific Recommendations for Factories and Workshops

These four specific recommendations then follow:

(a) "Over the 'working areas' of workrooms the illumination measured on a horizontal plane at floor level shall not be less than 0.25 ft.-candle, without prejudice to the illumination required for the work itself."

(b) "In all parts of foundries in which work is carried on or over which any person is ordinarily liable to pass the illumination measured on a horizontal plane at floor level shall not be less than 0.4 ft.-candle."

(c) "In all parts of factories and workshops (not included under recommendation "a") over which persons employed are liable to pass the illumination measured on a horizontal plane at floor level shall not be less than 0.1 ft.-candle."

(d) "In all open places in which persons are employed during the period between one hour after sunset and one hour before sunrise, and in any dangerous parts of the regular road or way over a yard or other space forming the approach to any place of work, the illumination on a horizontal plane at ground level shall not be less than 0.05 ft.-candle."

A modifying clause bearing on these recommendations is included for the purpose of defining the attitude of those responsible for these suggestions, as follows:

"These values are suggested without prejudice to the special illumination required for the carrying out of the work, which naturally varies greatly according to the nature of the operations. At present the committee is not prepared to recommend standards of illumination for these purposes, which require further investigation."

In order to meet exceptional cases in which the standards proposed in the foregoing recommendations might cause hardship, it is recommended by the committee that "there shall be power for the department to allow exemption in individual cases." An important reference to cleanliness of windows concludes the specific recommendations as follows: "All external windows of every workroom shall be kept clean on both the inner and outer surfaces." In this last case, however, provision is made for exceptional cases by the suggestion that power be given to substitute for this a definite and binding scheme for cleaning windows at reasonable fixed intervals where, for example, (a) the windows, or some of them (for instance, roof windows), are not readily accessible, or (b) the total surface of external windows is exceptionally large in relation to the floor space, or (c) the conditions of work are such that compliance with the ordinary requirement is, from the nature of the work, impossible.

The conclusion to the report proper gives such an excellent index into the attitude of this committee, as well as valuable information relating to the more important contents of the report, that it is herewith given in slightly condensed form:

"In submitting these recommendations we realize that the standards proposed by us appear to be lower than the values put forward by various lighting experts who have given evidence before us. Some of the latter referred to the general illumination at the working level, where the values are naturally higher than at the floor level, and in any case we have felt that they were intended as an indication of ideal conditions, whereas it has been our object to suggest numerical values that can be adopted as a practical legal minimum without causing hardship. It must be remembered that, in view of the diversity of illumination which always exists whatever the system of lighting, any minimum value will usually connote a very much higher maximum and average, so that with a given minimum the efficiency of the illumination depends to a large extent on this diversity. A workroom, for instance, in which the illumination is uniform and has the value of only 0.25 ft.-candle may be regarded in most cases as very inadequately lighted. We desire, therefore, to point out that none of the recommendations made by us is intended to supersede the requirements of general adequacy and suitability, which, as already explained, depend on several factors in addition to the amount of illumination.

No Distinction Made Between Types of Lighting

"The evidence before us from witnesses and our own observations do not justify us in drawing any distinction in the present recommendations between direct, indirect and semi-indirect systems of lighting, or between systems which differ in the color composition of the light. We suggest, therefore, that the standards proposed should be adopted irrespective of the type of lighting. Similarly, the evidence does not justify us in discriminating between natural and artificial lighting, and in the recommendations submitted by us the standards are intended to apply equally to both; that is to say, when the natural illumination falls below the limits proposed, it must be supplemented or replaced by artificial illumination.

"The more specific recommendations of this report may be said, broadly, to deal with the general lighting of factories and workshops; in other words, they have for their object the maintenance in all workplaces of certain standards of illumination primarily intended to insure the personal safety of workpeople moving about the premises. In the great majority of factories, however, the standards of general lighting suggested here would be inadequate for the actual machines and workbenches where the various manufacturing processes are carried on, and local lighting in addition is generally essential. As already mentioned, we are not prepared at present to suggest values for the minimum illuminations which may be regarded as adequate for special processes.

"The data given in several of the appendices will help those engaged in designing new factories and in examining the adequacy of lighting in existing buildings. At present there are few collated data of this character available, and the desire not to withhold them longer from publication is a further reason for the submission of a preliminary report at this stage."

It may be stated in conclusion that the appendix to this report, covering sixty-seven pages of unusually complete and exhaustive data, forms a document which should prove of great value to the lighting profession.

Flood-Lighting of the Waterbury (Conn.) City Hall During "Old Home Week"

During "Old Home Week" at Waterbury, Conn., Nov. 22 to 27, the city's new municipal building was illuminated from dome to foundations with a uniform intensity of about 4-ft.-candles by the aid of ten 500-watt flood-lamp projectors mounted on the roof of a building about 150 ft. distant. The United Electric Light & Water Company of Waterbury took an active part in the celebration of Old Home Week, furnishing the flood-lighting for the city hall during the entire period and also providing the energy for the "white-way" illumination. In collaboration with the Federal Sign Company, the local central station also furnished and erected an Old Home Week "Welcome" sign on one of the city's prominent buildings. At the office of the electric company and during the week there were demonstrations of electric ranges and appliances, and electrically cooked popovers, cake, toast, roast lamb and percolated coffee were served to all visitors. Adding to the general good feeling and gayety of the week, came also an announcement of a reduction in lighting rates after Jan. 1, 1916. Prosperity Week followed Old Home Week, and the lighting company continued its illuminations and demonstrations for the entire fortnight. F. J. Lyon, superintendent of the company, points out that much good has been accomplished by the lighting company's efforts during these two weeks, if only on account of the good feeling created by the company's activities on behalf of the city. The direct returns of the celebrations, evidenced in appliances sold and services connected, was also gratifying.

Marketing Electricity

A Department on Selling Service and Widening the Use of Electrical Energy

Taking Account of Psychology in Electric-Iron Sales Methods

The Milwaukee Electric Railway & Light Company's meter installers leave an electric iron with a red handle at the house of each new customer. With the iron is a printed tag inviting the new customer to try the iron with the company's compliments. After the customer has had the iron a few weeks a member of the sales department calls and explains the company's part-payment appliance offer and endeavors to sell the iron. About 50 per cent of the irons left in this manner are easily sold.

From the central station's point of view the real value of this method of iron selling lies in the fact that the first bill received by the customer is a bill including the energy used by the iron. If the iron is retained, all succeeding bills will in all probability be nearly the same in amount as the first one. Thus the company is spared the trouble that sometimes comes when customers notice increases in bills following appliance purchases.

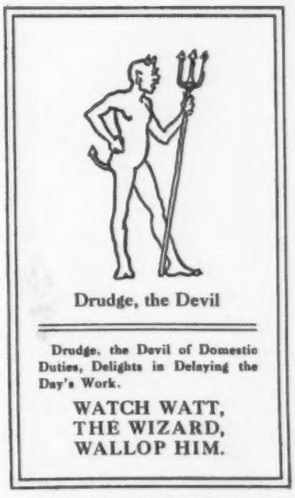
When the customer has decided to purchase an iron, a standard iron is delivered to the residence, and the red-handled trial iron is brought in, to be issued again to the metermen for delivery to another house. In all, the Milwaukee company has about 1200 of these red-handled irons in constant circulation among prospective heating-appliance customers.

Occasionally a customer is encountered who, suspicious of the good intentions of the company, believes the red-handled iron is a superior device used only for demonstrations. She wishes, therefore, to keep it in preference to getting a brand-new one from stock. In such cases a stock handle is taken to the house and there placed on the supposedly superior iron.

"Watt the Wizard" Conquers Household Drudgery at Baltimore

At Baltimore, Md., "Watt the Wizard" is engaged in a contest against "Drudge the Devil." Watt's fighting plan is to interest housewives in electrical methods for making their work lighter. The accompanying illustrations are reproductions of the first two of a series of striking posters printed in six colors and telling the story of useless drudgery resulting from the old-fashioned way of performing household tasks and the ease with which this necessary work may be accomplished by electricity at a minimum of labor and expense.

The posters are colored to portray the drab monotony


Drudge, the Devil
Drudge, the Devil of Domestic Duties, Delights in Delaying the Day's Work.
WATCH WATT, THE WIZARD, WALLOP HIM.

Watt, the Wizard
Where Watt, the Wizard, the Gas and Electric Magician, makes his entrance on the household stage Drudge, the Devil, makes a hurried exit. These advertisements will depict acts in domestic dramas. They are familiar scenes.

TWO OF SIX COLORED POSTERS DISTRIBUTED BY THE BALTIMORE LIGHTING COMPANY

of the work when modern conveniences are neglected. Contrasted with these are brighter pictures showing the modern way. A little narrative woven through the series points the moral.

A 22-Kw. Flood-Lighting Load at Indianapolis

Dignity and solidity characterize the effect produced by the new flood-lighted fifteen-story building of the Fletcher Savings & Trust Company at Indianapolis, Ind. The building has a frontage of 120 ft. on one street and 98 ft. on the other and is 210 ft. high. No attempt was made to illuminate it below the third floor because a frieze at that point separates the Crotch Island granite

PROJECTOR ILLUMINATION OF NEW FLETCHER BUILDING

used in the lower stories from the Bedford limestone above. On the two street sides the area of the illuminated surfaces is 28,776 sq. ft. On the other two sides, which have no street frontage, 6600 sq. ft. of space is lighted. For this work seventy-six projectors are used for the two larger surfaces, besides twelve others for the smaller ones. The battery of projectors for the street-corner surfaces is set in structural-steel frames about 110 ft. from the object walls on the roofs of adjacent buildings. The smaller batteries for the other surfaces are only about 50 ft. from the building. Each lighting unit consists of a Bryan-Marsh 250-watt gas-filled tungsten lamp placed in a National X-ray reflector. Using lamps of this size in the eighty-eight projectors, the load produced by the installation on the lines of the Merchants' Heat & Light Company is 22 kw.

Showing Up the Well-Lighted Windows

During the hours between dusk and 8.30 p. m. on one evening during Electrical Prosperity Week the Toledo (Ohio) Railways & Light Company extinguished all general down-town illumination except that operated from the electric-sign and window-lighting circuits. The company wished to give the public an opportunity to see how much illumination was provided from the signs and windows alone. Incidentally, the movement was a boon to the merchant with the well-lighted and well-trimmed window. Having been advised of the plan in advance, many merchants put special displays in their windows. The "stunt" had the effect of helping the business of the merchant with the well-lighted window and at the same time pointed out the need for good lighting to those who had not yet purchased modern illuminating equipment.

Noteworthy Christmas Illumination of Boston Store

The use of colored incandescent lamps in connection with plaster casts furnishes an excellent means of producing spectacular effects and is becoming a favorite mode of holiday advertising by large department stores. An elaborate display of this description is that of the Houghton & Dutton Company, Boston, Mass. The cast, which is of white plaster, is 55 ft. wide and 48 ft. high, and is attached to the corner of the building, at Tremont and Beacon Streets. The representation is of a castle, the "Home of Santa Claus," from which the figure of "Prosperity" is trumpeting good news. On either side, in a recess, is the figure of an eagle perched on a globe. Below are the traditional Santa and his deer.

The lighting is by means of 5680 20-watt and 1500 30-watt units, with red, white, green and yellow bulbs. These form the outline to the castle and produce the effect of sunbursts, electric fountains, trickling icicles and flying snow. Three flashers with a switchboard in a fourth-story room behind the display give intermittent operation to about 50 per cent of the lamps.

The sunbursts are produced by means of 182 red and yellow lamps, the four fountains by 680 clear lamps, and thirteen flower pots are studded with 156 units of various colors to represent flowers. There are 1500 clear lamps forming icicle effects.

Energy is obtained from the three-wire system of the Boston Edison company. The casts were modeled by Hugh Cairns, a Boston architect, and the electrical features were planned by G. L. Callahan.

CHRISTMAS LIGHTING ON BOSTON STORE FRONT

High-School Boys as Electric Appliance Salesmen

Details of a Successful Campaign Conducted by the Harwood Electric Company of Hazleton, Pa., Covering the Local Territory in a Short Period and with a Thoroughness Otherwise Impossible

BY J. S. WISE, JR., GENERAL MANAGER

THE Harwood Electric Company has had a very interesting and profitable experience in the utilization of the local schoolboy as a special campaign salesman, the experiment proving so successful in many ways that it suggests a very promising opportunity for future development. It was a ten-day selling campaign that featured the electric flatiron, toaster stove and percolator, and the results obtained both in direct sales of appliances and in the number of "prospects" turned in for other kinds of business were very gratifying. The idea of this campaign originated in the commercial department of this company, though we were assisted in the work by the Westinghouse company, whose appliances were sold.

THE SIXTEEN HIGH-SCHOOL BOYS WHO TOOK PART IN THE SUCCESSFUL CAMPAIGN IN HAZLETON

The campaign was centered in our Hazleton district, which comprises the city of Hazleton and several suburban towns, the combined population of the district aggregating about 50,000. In this territory there are seven electrical contractors who also handle appliances. These contractors and dealers were naturally benefited to some extent in their appliance sales through the publicity given the campaign by the Harwood Electric Company, and a certain percentage of sales went to them. However, these sales are not embraced on the tabulated report shown below, and this fact makes the results obtained all the more striking.

The Plan of the Campaign

The central idea of the campaign was to employ a staff of high-school boys as salesmen for a short period, and it had many points to recommend it. It gave an opportunity to cover a considerable territory very thoroughly in a personal canvass that promised good results in actual sales as well as much prospective business. Also, it brought us into immediate contact with a large number of homes known to the boys, among their friends and relatives, and greatly strengthened the feeling of good will between the community and the company, winning us the hearty co-operation of the city Chamber of Commerce in the campaign. Moreover, it returned all the commissions paid to the salesmen directly to our consumers and attracted an amount of favorable publicity that could not have been bought with money.

How the Boys Were Trained

The local high-school teachers were consulted, and when the campaign opened sixteen boys whose ages ranged from sixteen to twenty years presented themselves for employment. These boys were taken in hand by the commercial department, the campaign was outlined to them in detail, and by elementary lessons in salesmanship and blackboard talks the contract forms which they were to use were explained to them thoroughly, as a large proportion of their sales would embrace discount coupons and deferred payments—a dollar down and the balance in three monthly payments. No distinction was made in price whether the sale was for cash or on time, but the company insisted on the proper coupon being attached to each contract. To each boy were then given an iron and a percolator or an iron and a toaster stove, together with his solicitor's card, and his route was assigned to him. These routes were the same as the regular meter routes, but they were re-assigned daily so that each boy had an equitable division of good territory.

Before the boys went out a folder had been mailed to the list of prospective customers announcing the campaign and distributing the special coupons that entitled the holder to discounts of 50 cents on an electric flatiron or $1.25 on both the percolator and the toaster stove. The boys were paid at the rate of 50 cents an appliance, and all floor sales were combined and divided pro rata among them, cancellations, of course, being marked up against them. Their names were placed on the blackboard, with that of the leading boy first. This sustained live competition among them and made the struggle for supremacy the more keen. The method of procedure was simple.

Procedure and Results

The boys would bring in their contracts at night properly signed by the customer, these contracts being then turned over to the auditing department for the proper rating and, if accepted, passed on to the delivery department. Deliveries were made daily by a special truck employed for this purpose and bedecked with appropriate banners on both sides, and the first payment was collected by the Harwood employees as delivery was made, for the boys, except in special instances, were not allowed to collect any money. The first five days they were paid on all sales, this being done to encourage them, but for the second five days they were paid on the basis of delivery, and in all between $320 and $325 was given to these boys in commissions for their work. The sales for the campaign totaled 635 pieces, as shown in the accompanying statement. The cancellations num-

DEVICES SOLD DURING THE TEN-DAY APPLIANCE CAMPAIGN

6-lb. irons	512
Toaster stoves	70
Five-cup percolators	48
Seven-cup percolators	3
Traveling irons	1
Coffee urn	1
Total	635
Total watts	236,320
Total retail price	$2,179.00
Total calls made	5,106
Total "dead" prospects	2,860
Total "not at home" prospects	1,056
Total "live" prospects	355
Total cancellation, per cent	1½

bered only ten, or about 1½ per cent, and these cancellations were legitimate, this fact alone demonstrating the honesty and integrity of the boys employed and that they were entirely conscientious in their efforts.

In addition to the actual sales made, these boys brought in each day a large list of valuable "prospects" noted on their solicitors' cards, and to these proper attention was given. This feature of the campaign shows with what thoroughness and seriousness the boys went about their work, and it proves conclusively that the confidence of the management was not misplaced when they were selected for this selling work. This was one of the most successful campaigns ever conducted by the Harwood Electric Company, and we are receiving the commendation of the general public for the effort to foster home talent and advertise our own territory, for this campaign has attracted widespread notice and many inquiries for details have been received.

The Cost of Stock-Room Leakage, and Who Should Pay

By G. D. Crain, Jr.

In every stockroom there are losses—many of them unavoidable. The question is, Who should be called upon to bear the burden? It is an interesting topic, and one that concerns the jobber and the dealer, the contractor and the central station. This article suggests a practical and proper way to lock the profits safe, even though the leakage may continue, for if such losses are to a degree unavoidable, they should be recognized and properly provided for.

THE question of who should bear the cost of the unavoidable losses in stock leakage which every dealer and contractor must suffer is one that should have more consideration than it is receiving at present. Stock is stolen and stock is lost, and every item of that stock cost hard-earned coin. Who should pay for it? There is a diversity of opinion.

Theoretically such losses should not be permitted to occur. The stock-keeping system of every jobber, every dealer and every contractor, it would seem, should be sufficiently dependable to prevent the improper issuing of supplies, and exact a satisfactory and proved accounting for all material requisitioned for a job or shipment and not returned. But, as a matter of constant practice, it is found as impossible to avoid this waste through theft and accidental loss as to put an end to the never-stopping inroads of depreciation. The cost of theft, therefore, becomes in truth an item of actual overhead expense and should be reckoned into every estimate as carefully as percentages for rental, insurance or any other item in the expense of doing business.

"I have tried to get up a satisfactory system of stock-keeping," said a representative Middle Western dealer, "and I have given it up as a bad job. There are so many items, and the system has to be so elaborate, and so many corrections and credits must be made, that the labor involved is simply enormous. Our cost-keeping department is sufficiently busy with figures to make us want to restrict work along that line, and we have therefore abandoned the idea of trying to systematize stock-keeping, as far as written records are concerned.

"Our plan is simply to keep as close to the stock as possible. We carry about $10,000 worth of goods, and as we are constantly working in the merchandise, we know pretty well what we have and what we are running short on. Thus we do not need any system for that part of it. And our personal knowledge of the stock is such that we can discover thefts and other discrepancies very promptly. At least we have found a good many without the aid of anything except ordinary judgment in keeping track of things."

This is not to say that this and other good concerns have no system at all regarding stock, for in this man's stockroom nobody gets any material without having a regularly filled-out slip from the office, and when any goods are returned proper entries are made. The point is that the system has not been put on a detail basis which would follow the movement in and out of every item, no matter how small. But no system of book-keeping or personal supervision can be proof against some loss, and loss enough is met through the year to merit proper distribution as a factor in the overhead expense.

"I went down in the basement to-day and opened up a case of tungsten lamps," said a dealer recently. "I found that somebody had been there first, and nearly half of them were gone. That was a loss of about $12. I don't know whether they were stolen in transit or whether the theft was committed after they reached this store. All I do know is that the money for them must come out of our profits."

Another dealer, who is of a rather genial disposition, noticed that a big stock of flashlamps popular among suburban residents whose streets are not lighted was down to the vanishing point, although he knew that sales had not been heavy enough to move them all.

"Look here," he said one day when most of the employees were within earshot; "these flashlamps are nearly all gone. It seems to me that enough have been taken to give each of you one, and maybe a few have two. If you have, give one of them to those who haven't got one yet."

He simply assumed that the abstraction of novelty goods of that kind was going on, and that it was useless to attempt to prevent it or to threaten to "fire" those who had committed the petty thefts. Human nature seems weak in this respect—that, while few would steal money, a great many take "things" without many pangs of conscience. And the electrical man is one of those who lose right along.

Of course, sending out supplies to jobs that are in progress opens the way to losses, if the men care to

indulge in the gentle art of purloining the material that they happen to want for various purposes. If a man telephones that he is short a switch or a hundred feet of wire or a few knobs, the chances are that the material will be supplied without question. If the workman is not the right sort, his opportunities to steal create possibilities that are very far from profitable to the house. In this connection a successful contractor recently emphasized a point which it seems is worth careful consideration.

"I have on my force to-day," he said, "practically the same men I had five years ago. I keep them busy all the time. Instead of letting out my men as soon as work falls off, and then hiring a new lot when business improves, I keep the organization intact all the time. The result is that I know my men and feel that I can trust them. On the other hand, they are confident of holding their positions, and the incentive to take material which might be converted into cash to tide over a period of idleness is not present as it is when the temporary workman is put on a job.

"See that man there?" he continued. "I am paying him $2.50 a day, and to-day there is nothing for him to do. I am keeping him busy cleaning up the store, washing skylights, and straightening up the stock. Another chap who couldn't be used outside to-day has been put at work with a brush, staining some shelves we recently put up. In this and other ways we make work for them around the store, so that they are kept on the pay-roll whether business is rushing or not.

"I feel that this is a paying proposition, not only from the standpoint of saving our concern from losses and little leaks of various kinds, but because I have the pick of the electricians of the town. In the long time I have had these men I have had the chance to test them and to find out which are the good men and which are the less efficient ones. The result is that I have kept the best and rejected the others. The present force is all composed of reliable, profitable workers. I can afford to pay them occasionally when they are not working because of the increased profit I make when they are out on the jobs.

"I know of some contractors who are constantly changing, feeling that they can never carry a man if he can't be employed on a job. One such contractor is now handling a big wiring job in which six men are absolutely new to him. Those six probably know that they will be let out when the present work is completed. Are they going to hew to the line as closely, regarding material and soldering and handling the work generally, as they would do if they were steady employees who had a permanent connection with his business?"

The amount of the losses suffered through thefts can hardly be stated with any certainty, because it is bound to vary widely and because, in the very nature of the case, it is difficult to discover the losses when they happen. Some concerns estimate it as high as 1 per cent of their gross business. Others think that from one-quarter to one-half of 1 per cent would cover the amount in their cases.

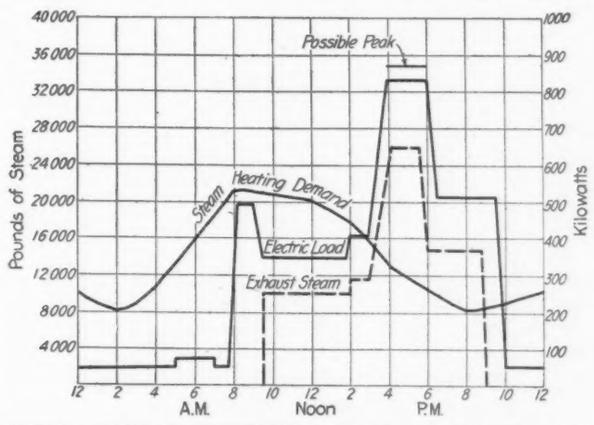
It should be remembered, in working on a proposition of this kind, that the amount should be compared not with the gross business but with the net profits. A sum that may seem small as part of the gross will be from eight to ten times as great in proportion to the profits of the business, and therefore the loss must be eliminated in the only way possible—by figuring it into the overhead expense and making a charge for it on every job and in every sale. It is the only safe way to run the business.

It may seem like locking the stable after the horse is stolen—but it serves to lock up profits, if not goods.

Steam-Heating and Electric-Service Curves Show Fallacy of Isolated Plant for Office Building

A set of curves drawn up to show the estimated divergence of the steam-heating and electric loads for a proposed large office building and used to establish the fallacy of installing an isolated plant secured the contract for the central-station company recently in St. Paul, Minn. Office-building service is one of the forms of business which the central-station manager sometimes finds hardest to get, because, at first thought, power generation and exhaust steam heating from an isolated plant, taken together, seem to offer exceptional economy, whereas in reality the two forms of load do not co-ordinate well to produce a low energy cost. But it took this set of curves to show irrefutably the low efficiency and high cost which must result from the private plant, as compared to the cost of service from a central plant equipped to supply steam for heating as well as electric energy.

A glance at the curves shown herewith, which are one of several sets drawn up for the varying load conditions of the different seasons, shows clearly how the demand for steam for heating during the morning hours is substantially in excess of the exhaust from the engines carrying the electric load. In the afternoon, on the other hand, the exhaust steam is in excess of the heating requirements. In other words, during the morning hours and until 1 or 2 o'clock in the after-



CURVES SHOWING DIVERGENCE OF STEAM-HEATING AND ELECTRIC LOADS

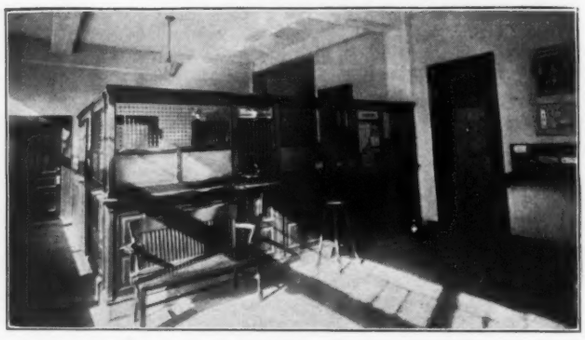
THE NEW RAILROAD OR "HILL" BUILDING RECENTLY COMPLETED AT ST. PAUL

noon live steam must be used for heating, and after that part of the engines must exhaust atmospherically unless condensers are installed. Such an installation of condensers offers several disadvantages, of which the first is the initial investment and fixed charges thereon, and then follow the cost of cooling water and the space required.

The ideal isolated plant would be one made up of units of various sizes so that just enough engine capacity could be operated against back pressure to supply the exhaust steam for heating and the rest could be operated condensing. Even with such a plant layout, the lower efficiency of the smaller units and the varying weather conditions make it hard to effect the economy expected.

The central-station company, however, on account of its great diversity of load is equipped by the very nature of things to supply the two forms of energy at the most economical price for each without regard to the other, even though, as shown by the curves, they are practically opposite in characteristics. The curves show the absence of any relation between the two forms of energy requirement and point out the practicability of employing such a source of energy as is not dependent for economy of operation on co-ordination of the two.

The St. Paul office building in question is known as the Railroad Building and is to be supplied with electricity and steam by the Consumers' Power Company. It will house the offices of the Great Northern Railway, the Northern Pacific Railway, the First National Bank, the Northwestern Trust Company, the Great Northern Ore Properties and other interests of James J. Hill. The three-phase, sixty-cycle, 2300-volt current will be measured on the high-tension side of the transformers. The connected power load will comprise 1060 hp. One 75-hp. motor-generator set supplies direct current to three private self-operating elevators and a pneumatic-tube system. All of the other motors are three-phase, and they include 85 hp. for fans, 600 hp. for elevator pumps, 55 hp. for air compressors, 195 hp. for fire and house pumps, 50 hp. for vacuum pumps, and the equivalent of 25 hp. for two blueprinting outfits. The connected lighting load amounts to 700 kw. The building will be heated by 70,000 sq. ft. of direct radiation and 5000 sq. ft. of indirect radiation, for which steam will be supplied at a pressure of 1 lb. or less.



THE NEW OFFICE OF THE NOBLESVILLE (IND.) HEAT, LIGHT & POWER COMPANY—AN INVESTMENT WHICH HAS PAID ITS OWN WAY

OFFICE FOR A SMALL CENTRAL STATION

Advantages of Company Owning Its Building — How the Noblesville (Ind.) Company Made the Investment Pay

BY JOHN T. KESTER, MANAGER

Frequently in the consideration of a new office the small central station thinks it has no alternative but to rent the most suitable store available. There is, however, a good deal of advantage in being identified with the ownership and permanent location of an office building that shall be conspicuous in the mind of the public. The high value of property in a desirable location may make the investment prohibitive for the requirements of the electric company alone, yet the advantages to be gained through a display room and office designed for the purpose are so much to be desired that some special means of making the investment a paying one may well be adopted. The Noblesville (Ind.) Heat, Light & Power Company has solved the problem.

A corner lot on the main street one block from the court house and just across the alley from the company's power house was purchased. An old frame house on the property was situated so well back from the street that it provided ample space to erect a new building at the side walls. The old house was left standing and the architecture of the new building made to harmonize with it by an adapted colonial design for the office and a new front porch for the old house. This house was then rented and became a source of revenue.

The new building was laid out to provide a suitable display space for appliances, a convenient office arrangement, and rooms for storage of supplies and line materials, meter-testing room, locker room for linemen, etc. These occupied the first floor and basement, and the second floor was built for a flat. The construction is reinforced concrete up to the second story and fireproof tile covered with stucco above this, making a fireproof building.

Financially the problem worked out as follows:

Original investment in lot and house	$5,500
Cost of building	9,000
Total investment	$14,500
Interest on $14,500 at 7.2 per cent (yield price of bonds sold)	$1,044
Taxes	200
Fire insurance	40
Total expenses	$1,284
Rent from flat at $30 per month	$360
Rent from old house at $25 per month	250
Rent saved by company, $75 per month	900
Total earnings	$1,510

As the expenses, taking into account repairs and depreciation, practically balance the receipts, it will be seen that the profit to the company lies in the advertising value of the building, the excellent facilities which could not be obtained in a rented home, and in the proximity to its power station, which will result in closer co-operation between the power house and the office.

Illumination Calculations for the Electrical Contractor

BY LOUIS W. MOXEY, JR., VICE-PRESIDENT KELLER-PIKE COMPANY, PHILADELPHIA

This article, which concludes the series of seven prepared by Mr. Moxey on the subject of business methods for the electrical contractor, takes up the important subject of illuminating engineering and outlines methods of computing the number and size of lamps required to produce desired illumination under given conditions. A number of tables useful in illumination calculations are also presented. The preceding articles of the present series dealt respectively with general business methods for the electrical contractor (Oct. 16), labor costs in interior construction (Oct. 23), accounting and cost-keeping methods (Nov. 20), calculation of wire sizes for direct-current circuits (Dec. 4), calculation of wire sizes for alternating-current circuits (Dec. 11), overhead and underground construction (Dec. 18).

A GREAT many contractors merely "guess at" the number of lamps required in the average installation. As a result, it often happens that either too few or too many are installed. In either event the customer is dissatisfied. In the first case he does not obtain the good illumination desired, while in the second case his lighting bill is excessive if all the lamps are used. The customer can, of course, change the size of the lighting units, but this should not be necessary.

Recently, however, there has been an improvement in this respect as the result of the educational campaigns that have been conducted by lamp and reflector manufacturers. Several comparatively easy and satisfactory methods have been devised for calculating the number of lamps required in the average installation.

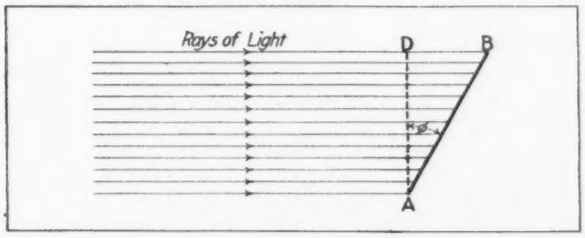


FIG. 9—INTENSITY OF ILLUMINATION ON AN INCLINED SURFACE

Definition of Terms

In order to be able to solve illumination problems the contractor should make himself familiar with the following terms and their definitions:

The candle-power is the unit of light production and is defined as the light from a standard international candle burning under exact specifications. When a source of light is spoken of as being of 16 cp., it is meant that its intensity equals that of sixteen international candles. In general, however, the candle-power of a source of light is not the same in all directions.

The foot-candle is the unit of intensity of illumination. As such it is the intensity of illumination produced by a 1-cp. source on a surface 1 ft. from the source and perpendicular to the direction of the light. The intensity of illumination of a unit surface perpendicular to the beam of light incident upon it is directly proportional to the candle-power of the source of light and inversely proportional to the square of the distance of the point from the source.

Calling I the intensity of illumination, in foot-candles, of a unit surface perpendicular to the rays of light incident upon it, c the candle-power of the source, and d the distance in feet from the surface to the source of light, the following formula is obtained: $I = c/d^2$.

Now, if the surface is not perpendicular to the beam of light incident upon it, as is the case with the surface represented by the dotted line AD in Fig. 9, but at an angle to it, such as the surface represented by AB, the intensity of illumination is reduced. A glance at the figure will show how this is true, for in the case of the surface AB the same number of light rays are distributed over the surface as over the smaller surface AD. Hence the intensity of illumination of the surface AB compared with the intensity on a surface at right angles to the rays of light is in the ratio of the length of the line AD divided by the length of the line AB. This relation may also be expressed by the formula in which the resulting intensity $I = c/d^2 \cos \varphi$, where the angle φ is the angle between the surface AB and a surface AD perpendicular to the rays of light incident upon AB. The expression $\cos \varphi$ is simply a mathematical way of indicating the ratio of the lengths $AD \div AB$.

These formulas, of course, assume that all rays of light incident upon the surface come directly from the one source considered, and that no reflection from walls, etc., takes place. It is also assumed that the surface under consideration is small enough and situated at a great enough distance from the source of light to justify the assumption that the rays of light incident upon it are practically parallel.

Candle-power Curves

Before considering the calculation of the number and spacing of lamps required for proper illumination of rooms devoted to various purposes it is best to study the distribution of light in the case of the common tungsten-filament lamp with and without an extensive type of reflector. Fig. 10 shows candle-power measurements taken of a 40-watt tungsten-filament lamp at various angles, both with (curve B) and without (curve A) an extensive-type Holophane reflector. The lamp is assumed to be at the center of the concentric circles in such a position that the tip of the glass bulb points downward to what corresponds to the bottom edge of the page. Readings were taken at every 15 deg. in a

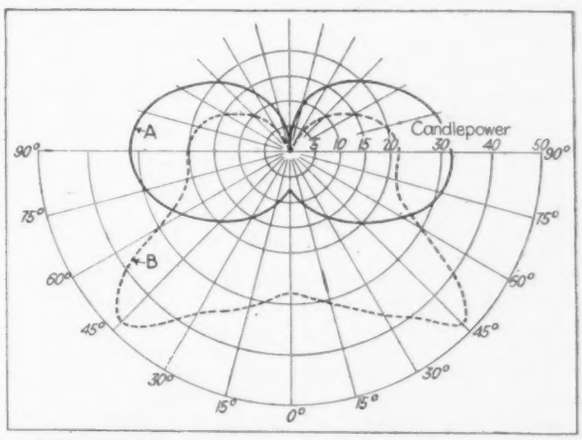


FIG. 10—CANDLE-POWER CURVES FOR 40-WATT TUNGSTEN LAMP WITH AND WITHOUT EXTENSIVE REFLECTOR

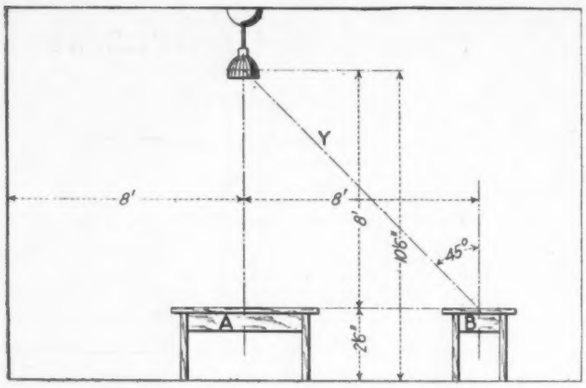


FIG. 11—ILLUMINATION FROM CEILING FIXTURE

plane passing through the glass stem supporting the filament of the lamp.

It will be noticed from curve *A* that a bare tungsten-filament lamp has its maximum candle-power intensity in a horizontal direction. Directly beneath the lamp the candle-power is very low. The zero reading at the top of the lamp is, of course, due to the fact that the base of the lamp intercepts all light in that direction.

Curve *B* shows the distribution when an extensive type of Holophane reflector is used. The curve clearly shows that such a reflector causes a more desirable distribution of the rays of light from the lamp.

Intensity of Illumination

In Fig. 11 is given a diagram of a room illuminated by means of a 40-watt tungsten-filament lamp placed in the center of the ceiling and equipped with an extensive-type reflector. This diagram will be used to illustrate some of the principles heretofore discussed.

Let it be required to find the intensity of illumination on the unit areas *A* and *B* of the two tables indicated, the effect of reflection from all surfaces being neglected.

From the curve in Fig. 10 it is found that the vertically downward candle-power of the 40-watt lamp with an extensive type of reflector is 28 cp. Now the distance from the center of the lamp to the surface of the table at *A* is 8 ft., the surface of the table being assumed to be 2.5 ft. above the floor level. In most illumination problems it is generally assumed that the plane of illumination is at this distance above the floor, since the surfaces of tables, desks, etc., average about this height. The point *A* is assumed to be directly beneath the center of the incandescent lamp above, and hence the rays incident upon a small area at *A* will be practically perpendicular. Hence the following formula applies:

$$I = c/d^2 = 28 \div (8 \times 8) = 0.438 \text{ ft.-candle.}$$

Now, let it be required to find the intensity of illumination at a unit surface *B* on the table shown at the right in Fig. 11. In this case the point considered, *B*, is 8 ft. below the lamp and 8 ft. to the right. Hence the distance *y* is about 11.3 ft.

$$(\sqrt{8^2 + 8^2} = \sqrt{64 + 64} = \sqrt{128} = 11.3).$$

Referring to Fig. 10, it is seen that the candle-power of the lamp at an angle of 45 deg. below the horizontal is approximately 47 cp.

As the rays of light *y* strike *B* at an angle of 45 deg., the formula applies:

$$I = c/d^2 \cos \varphi = 47 \div 128 \cos \varphi$$
$$= (47 \div 128) \times 0.707 = 0.26 \text{ ft.-candle.}$$

In the same manner the intensity of illumination at any point in the room may be obtained.

The intensity of illumination at any point in a room, however, depends also upon other factors which as yet have not been taken into consideration. The most important of these is the effect produced by the reflection of light from walls, ceilings, etc. In Table XLII are given the percentage correction factors which should be applied to results obtained as previously described in order to obtain a more accurate estimate of the intensity of illumination at any point. This table and all others in this installment are based on data furnished by manufacturers of lamps, shades and reflectors. It is thus seen that the results previously obtained should be increased by from zero to 80 per cent, depending upon the condition of the walls and ceilings.

Calculation of the Size of Units

A reversal of the process outlined will permit calculation of the size of lighting units to be installed in order to produce a certain intensity of illumination at given points.

Let it be assumed that an intensity of illumination of 0.3 ft.-candle is desired at *A* in Fig. 11, the room having ceiling and walls of medium color. From Table XLII it is seen that the effect of the reflection from ceilings and walls is to increase the average illumination about 40 per cent. Hence 0.3 ft.-candle represents 140 per cent of the intensity of illumination due to direct light from the lamp above, and the rays of the lamp must provide an intensity of illumination at *A* of

TABLE XLII—EFFECT OF NATURE OF WALLS ON ILLUMINATION

Color of Ceiling	Color of Walls	Increase of Calculated Illumination, per Cent
Very dark	Very dark	0
Medium	Very dark	15
Medium	Medium	40
Very light	Very dark	30
Very light	Medium	55
Very light	Very light	80

TABLE XLIII—ABSORPTION OF LIGHT BY GLOBES

Material	Percentage
Clear glass	5 to 12
Light sand-blasted glass	10 to 20
Alabaster glass	10 to 30
Canary-colored glass	10 to 20
Opaline glass	15 to 40
Ground glass	20 to 30
Medium opalescent glass	20 to 40
Opal glass	25 to 60
Heavy opalescent glass	30 to 50
Milk glass	30 to 60
Signal-green glass	80 to 90
Light-green glass	30 to 40
Ruby glass	85 to 90
Cobalt-blue glass	90 to 95

TABLE XLIV—DESIRABLE SIZES OF SQUARES FOR SPACING OUTLETS

	Ceiling Height	Desirable Length of Sides of Squares
Armories	12 ft. to 16 ft.	12 ft. to 16 ft.
Auditoriums	12 ft. to 16 ft.	12 ft. to 16 ft.
Public halls	Over 16 ft.	15 ft. to 26 ft.
Rinks	Over 16 ft.	15 ft. to 26 ft.
Stores	8 ft. to 11 ft.	8 ft. to 11 ft.
Stores	11 ft. to 15 ft.	10 ft. to 16 ft.
Stores	Over 15 ft	10 ft. to 16 ft.
Stores	Over 15 ft.	14 ft. to 22 ft.
Offices with individual desk lamps	10 ft. to 20 ft.	12 ft. to 18 ft.
Offices without individual desk lamps	9 ft. to 12 ft.	7 ft. to 11 ft.
Offices without individual desk lamps	12 ft. to 16 ft.	9 ft. to 14 ft.
Offices without individual desk lamps	Over 16 ft.	11 ft. to 18 ft.

0.3 ÷ 1.40 ft.-candle, or 0.214 ft.-candle. Since from the formula already given, $c = Id^2$, substituting,

$$C = 0.214 \times 64 = 13.7 \text{ cp.}$$

To find the size of lamp required it would be necessary to have curves of distribution of candle-power of numerous sizes of lamps equipped with various shades and reflectors at hand. The lamp and reflector or shade arrangement which shows a candle-power of 13.7 in a downward direction would be selected if other conditions were not to be taken into account.

However, in most illuminating problems it is necessary to fulfill specifications for intensity of illumination at more than one point in the room.

By applying the method outlined for various points in a room it is, of course, possible to find the combination of lamps and reflectors that will approximately fulfill the required conditions. This method of calculation, however, requires the plotting of curves showing the distribution of light for numerous sizes of lamps with various types of shades and reflectors. The method can be applied to rooms in which only one unit is required, but when extended to several rooms where more than one lighting unit is to be installed it becomes very laborious. Hence recourse is generally had to another method of calculating the size of lighting units required.

The Flux-of-Light Method

The flux-of-light method is based upon the idea of luminous flux; that is, luminous energy proceeding from the source into space in all directions. Consider a lamp placed at the center of a sphere of unit radius so that one unit of area of this sphere may represent one unit of solid angle, then a lamp giving an intensity of illumination of 1 cp. in every direction will cause a certain amount of light or light flux to pass through a unit cone; that is, through an area of unit size on the surface of the sphere. This unit of light flux is called a lumen of light flux. In other words, the lumen is the quantity of light falling on 1 sq. ft. of a sphere of 1-ft. radius from a light source of 1 cp. intensity at the center of the sphere.

TABLE XLV—INTENSITIES OF ILLUMINATION FOUND SUITABLE FOR VARIOUS PURPOSES

Installation	Foot-Candles
Auditoriums	1 to 3
Theaters, general illumination	1 to 3
Churches, general illumination	2 to 3
Reading rooms	1 to 3
Residences, general illumination	1 to 2
Desk illumination	2 to 5
Postal service	2 to 5
Bookkeeping	3 to 5
Stores, general	2 to 5
Stores, clothing	4 to 7
Drafting	5 to 10
Engraving	5 to 10

TABLE XLVI—EFFECTIVE LUMENS PER LAMP

	Tungsten-Filament Lamps—Watts per Lamp					
	25	40	60	100	150	250
Effective lumens per lamp..	95	160	250	420	630	1090
	Graphitized Carbon-Filament Lamps—Watts per Lamp					
	30	40	50	60	80	100
Effective lumens per lamp..	50	80	100	125	120	210

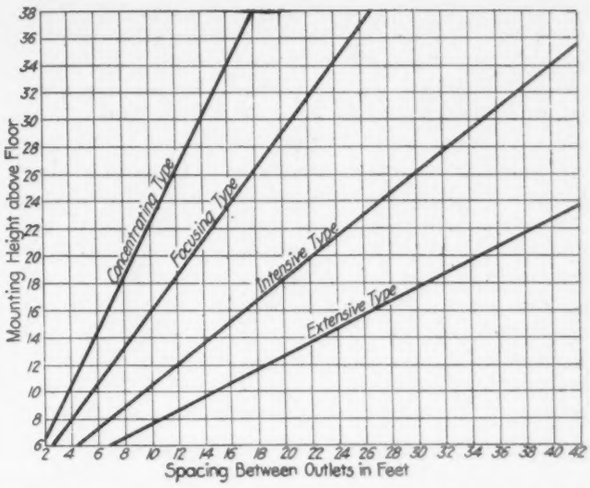


FIG. 12—CURVES FOR SELECTING TYPE OF REFLECTOR

This method is generally applied in the shape of the following formula:

$$\text{Number of lamps} = \frac{S \times I}{\text{effective lumens per lamp}},$$

where S = the number of square feet floor area of the room and I = the required average intensity of illumination required in foot-candles. The term "effective lumens per lamp" refers to the total light flux from lamps that is available for illumination purposes.

To illustrate this method the following example may be cited. A storeroom to be lighted measures 40 ft. by 100 ft. Considering the goods to be sold, it is decided, after referring to the table of foot-candle intensities recommended for various classes of service (Table XLV), that 3 ft.-candles is sufficient for general illumination. Then the total lumens of light flux required would be three times the area in square feet, or $40 \times 100 \times 3$, which is equal to 12,000 lumens. By turning to the table of effective lumens for tungsten-filament lamps it is found that the number of 25-watt lamps necessary would be 12,000 ÷ 95, or 127. With 40-watt lamps 12,000 ÷ 160, or 75, would be required.

These calculations are subject to correction for color of the wall and ceilings, types of reflectors used, etc. For example, if reflectors are to be used in the store referred to above, and the walls and ceiling are of medium tint, the effective lumens from the lamps may be considered as 10 per cent greater. If opaque reflectors were used instead of clear glass, the increase in illumination resulting from light ceilings and walls would be negligible, while if certain kinds of opal glass shades were used the influence of color of the ceiling and walls would be greater. It is somewhat difficult to estimate the difference in resulting illumination with different color decorations, and in residence work, where the wall-paper may be changed from time to time, it is not wise to rely too much on reflection from surfaces.

For lighting by the use of indirect-lighting fixtures the writer has found the flux-of-light method to be very satisfactory when based on 0.4 watt per foot-candle for each square foot of horizontal surface to be illuminated.

To find the proper type of reflectors to be used curves like those shown in Fig. 12 may be employed. To find the proper shade to be used, knowing the height of the unit above the floor level and the spacing between units, follow the vertical line representing the spacing between units until it intercepts the horizontal line marked "mounting height," and use the shade which is shown by the diagonal line to be nearest the point thus located.

HALL AND DRAWING-ROOM OF "BROWNSTONE FRONT" CONVERTED INTO FIXTURE SALESROOMS

An Old-Time New York "Brownstone Front" Converted Into Fixture Salesrooms

An exceedingly interesting innovation in the arrangement of appropriate environment for the display of ornate fixtures has been executed by the H. W. Johns-Manville Company in New York City. One of the now fast-disappearing "brownstone fronts" that were so characteristic of New York's aristocratic mansions a generation ago has been acquired and converted into fixture and display salesrooms. The fact that this old home is immediately adjacent to the company's large modern building makes it particularly convenient.

The interior decorations of the old residence have been restored and the rooms handsomely furnished and equipped with fixtures selected to harmonize with the character of each interior. The hall pictured above, with its Caen-stone finish and Venetian-red carpets and hangings and its Italian-stone bench and stairway, gives a setting for ornamental portières, Florentine iron vases, various types of classical bracket fixtures, a copy of the famous Strozzi lantern, and a massive bronze stand surmounted by a four-arm vase that is copied from an ancient oil-burning fixture. The drawing room, also pictured above, with its French setting, displays a wealth of artistic pendants, brackets, stand and candle-type fixtures. The black walnut walls of the dining-room extend up within 2 ft. of the ceiling, where there is a cove to display the cove-type indirect-lighting system, and this room, which is distinctly English in character, is used to display a variety of chandeliers. The arrangement described is shown in the illustration below.

On the second floor the fixtures displayed are more modest in design and include table and piano lamps, bedroom and music-room fixtures and the like, patterned after models of the Colonial, Old English and Jacobean periods. The three rooms on the third floor are devoted entirely to the display of commercial fixtures, including bowls and shades of Parisian glassware with "Polarite" glass signs, indirect-lighting systems employing "Linolite" lamps and Frink continuous reflectors and fixtures for the bank, office, hospital and kindred service. Two interesting fixtures shown for use over operating tables are of the pendent type with double glass bottoms to prevent any heat passing downward.

The advantage of such a display in such an environment over that seen in the ordinary store with its conglomeration of fixtures and lights of all kinds, shown too often without any regard to setting, can be readily imagined. The architect can take his client to such a place and give him some idea of how a recommended type of fixture will look, and the standard service represented to the customer is of such importance that it is thought similar display quarters will be established by the company in other large cities.

DINING-ROOM AND EXTERIOR OF ONE-TIME RESIDENCE ON MADISON AVENUE, NEW YORK CITY

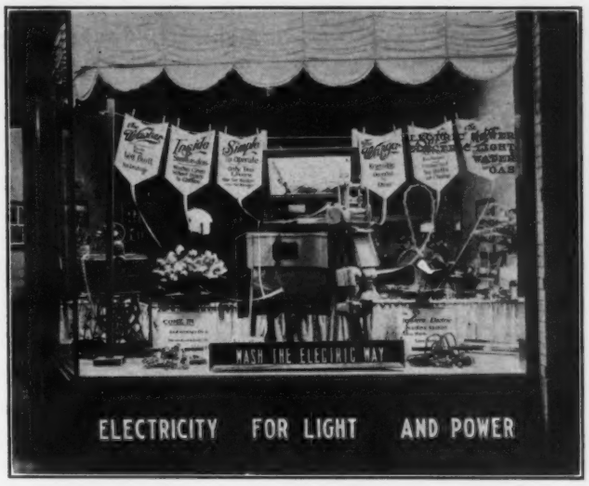


EXHIBIT AT THE TIME OF THE FALL "OPENING"

An "Opening" for Christmas Business—An Idea That Can Be Used to Advantage at Any Time of the Year

One day in early September the merchants of Warren, Ohio, kept their windows screened all day. Then at 7 p. m., when the central-station display-window circuit was turned on, all screens were taken down and well-lighted show windows flashed forth as a brass band marched around the public square to a lively tune. The event was termed a "fall opening." In reality it was a central-station affair cleverly managed.

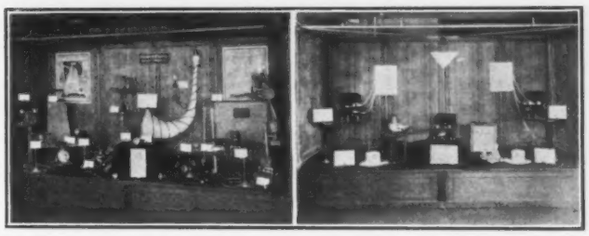
The executives of the Trumbull Public Service Company of Warren, who originated the idea, had gone to the local merchants' league and had told its members that if they wished to conduct such an opening the central-station company would loan extra window lamps for the occasion and allow them to be operated gratis in the display circuit. From this point on the real work of organizing for the opening was done by the merchants' league and by the local newspapers.

The affair was a great success and drew large crowds to the down-town district. But, what is more to the point, it increased the local central-station company's revenue about $500 a year, because on the following day, while the merchants were still enthusiastic over the opening, the new-business solicitors called attention to the better appearance of the windows which, with borrowed lamps, had shone so brightly the night before. Contracts for increased window lighting were easily closed that day.

The favorable way in which the merchants viewed the opening is further evidenced by the fact that on Dec. 1 the "stunt" was repeated and was termed an opening for Christmas business. Electrical decorations for the latter affair were more elaborate than for the first one. "Shop in Warren" signs electrically lighted were hung on all corners of the public square. Twenty-five electrically lighted Christmas trees were arranged on the principal business streets.

Making Good Use of the Jobber's Suggestions for Window Publicity

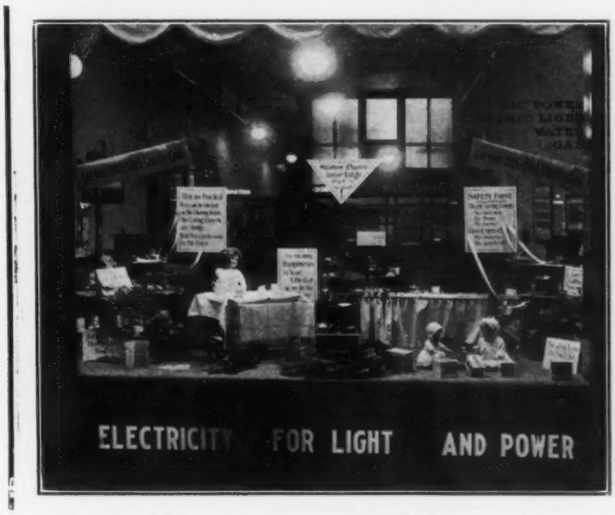
The intelligent use of suggested ideas for window trim sent out by the jobber and manufacturer for Prosperity Week and Christmas displays produced the striking exhibit shown herewith in the window of the Utah Light & Power Company, Salt Lake City, Utah. It em-



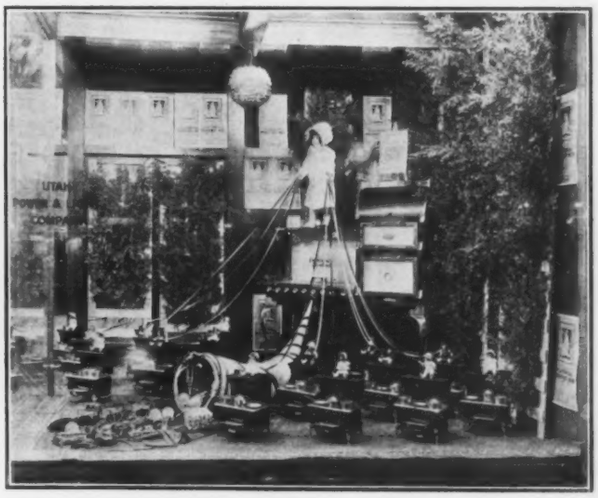
THE ORIGINAL WINDOW SUGGESTIONS OFFERED BY THE JOBBER

bodies the ideas offered by the jobber, yet also shows a good deal of local original thought, and the result is a most pleasing improvement on the suggestion.

The jobber, which was the Western Electric Company, suggested in a note at the bottom of its Christmas window-display literature that a Christmas tree might be substituted for the cornucopia if desired, but the ingenious Salt Lake City trimmer used both. He secured the Prosperity Week significance by incorporating the "horn of plenty" in the trim, and gained a holiday flavor by utilizing Christmas-tree foliage as an effective background. Then he added to the display idea of the toy stoves, putting in one big stove for "mother" and a lot of baby stoves for the "little mothers"—with the offer of a doll free with each as an added attraction.



CHRISTMAS DISPLAY IN CENTRAL-STATION WINDOW AT WARREN, OHIO



THE SALT LAKE CITY WINDOW COMBINING THE ABOVE SUGGESTIONS

Power Engineers Versus Power Salesmen—Which Type of Man Gets the Motor Business?

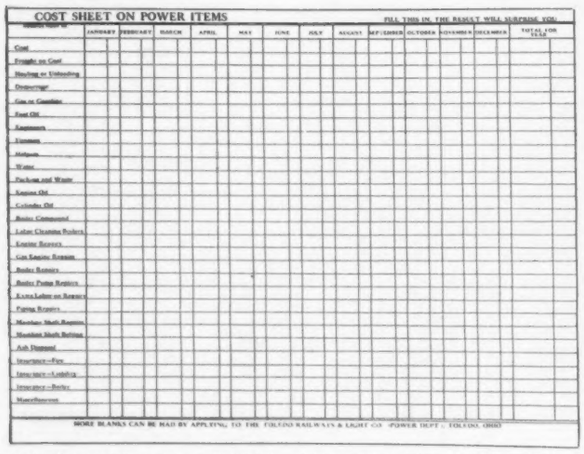
A paper by H. J. Kunz of Toledo, Ohio, on "Power Sales Problems," read before the last convention of the new-business co-operations committee of the Ohio Electric Light Association, brought out the ideas of several delegates on sales methods. For the isolated plant owner who is secretive, who refuses to give out power costs, and who repulses all advances of the central-station representatives endeavoring to present a proposition, Mr. Kunz has prepared a data sheet by which such a prospective customer may be made actually to sell himself central-station electric service. This data sheet contains merely a list of the items likely to be included in any isolated-plant owner's power bill and provides a place for entering each expense item for each month. When the data blank is left with a prospective customer as a last resort, he is advised that if he will keep his power costs he will be surprised.

W. A. Wadsworth of Cincinnati, in relating the experience of the Union Gas & Electric Company, said that the "trial proposition" for selling motor service had been used with signal success. When salesmen are empowered to offer prospective power users a three-month trial of electric motor service they do not need to call in a power engineer and enter into a lengthy discussion of details and costs, most of which is not fully understood by the average manufacturer. With the trial offer the salesman has a plain business proposition to lay before his customer. In his initial effort the salesman tries to sell the installation outright. But if his "prospect" is skeptical the salesman says: "We are so sure that electric service will be better and cheaper for you to use that we will install motors in your plant without cost to you. If after three months you decide to keep our service, the motors and wiring will cost you the amount named in our agreement. If our service is unsatisfactory, you merely pay the power bill for the three months." In approaching a customer, continued Mr. Wadsworth, it is well always to mention the cost of wiring and motors as a lump sum and not to bother and confuse a customer with details.

When considering the use of a trial offer, the Cincinnati company analyzed the prospective customers in its field, securing the co-operation of motor manufacturers, local used-machinery concerns and wiremen. The possibilities of loss from the plan were considered, but when there were taken into acount the facts that considerable revenue would result from the energy used during the three months' trials, that the selling cost by this method is about one-third that of other methods, and that some "prospects" at least would become customers much sooner, the possibilities for failure did not loom large. So far no installations have had to be removed, although the trial offer has been accepted by customers owning installations ranging from 10 hp. to 600 hp. Sometimes when the trial offer is made it is not accepted because the customer, seeing the electric service company's confidence in its own product, is himself convinced and buys his equipment outright.

F. B. Steele of Dayton declared his belief in the usefulness of the power engineer. His reports on a prospective customer's present and probable future power costs are invaluable for attracting the customer's attention. Mr. Steele also pointed out the fact that many companies could not secure the co-operation of local firms to help carry accounts during the trial periods.

Mr. Kunz summed up the arguments for the power salesman and for the power engineer by stating that a man to be really successful should be able to be either salesman or engineer as the occasion demands and as the prospective customer desires. No matter how the proposition is submitted, concluded Mr. Kunz, it should show the customer a saving of at least 20 per cent so that his investment might be wiped out in five years.


COST SHEET ON POWER ITEMS

FILL THIS IN, THE RESULT WILL SURPRISE YOU.

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	TOTAL FOR YEAR
Coal													
Freight on Coal													
Hauling or Unloading													
Dockwage													
Gas or Gasoline													
Fuel Oil													
Engineers													
Firemen													
Helpers													
Water													
Tackle and Waste													
Engine Oil													
Cylinder Oil													
Boiler Compound													
Labor Cleaning Boilers													
Engine Repairs													
Gas Engine Repairs													
Boiler Repairs													
Boiler Pump Repairs													
Extra Labor on Repairs													
Piping Repairs													
Machine Shaft Repairs													
Shafting Shaft Bolting													
Ash Disposal													
Insurance—Fire													
Insurance—Liability													
Insurance—Boiler													
Miscellaneous													

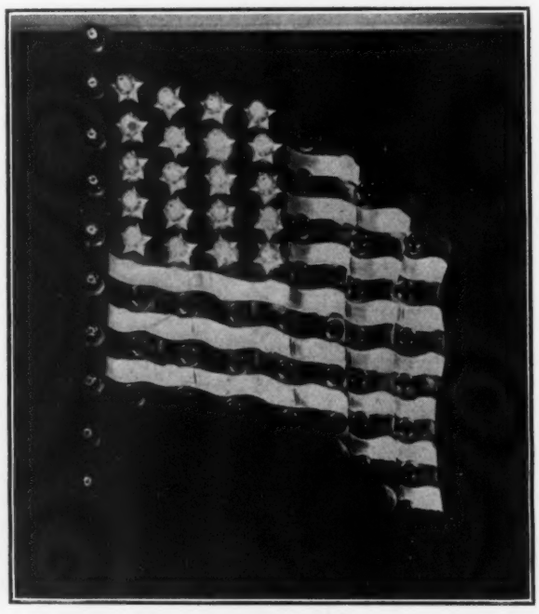
MORE BLANKS CAN BE HAD BY APPLYING TO THE TOLEDO RAILWAYS & LIGHT CO. POWER DEPT., TOLEDO, OHIO

BLANKS USED BY TOLEDO COMPANY IN CAMPAIGN TO SHOW ISOLATED-PLANT OWNERS THEIR POWER COSTS

A Sign That "Goes Like Wildfire"

There is perhaps no central-station sales manager who proportionately has had greater success in selling electric signs than A. K. Young of the Toledo (Ohio) Railways & Light Company. His statement that the sign shown herewith is the best seller the Toledo company has ever handled will, therefore, bear repeating. In three weeks the salesmen of the Toledo company sold forty-two of these American-flag signs. To quote E. R. Kelsey, the company's genial manager of publicity: "The flags have been going like wildfire. We just wired the Valentine Sign Company to hustle all the flag signs available to us. There is no doubt that we shall sell 250 of these signs here."

The sign measures 4 ft. by 5 ft. and is equipped with thirty-three red lamps, ten white lamps and twenty blue lamps. The sign is single-sided and may be placed flush against a wall on either the inside or outside of a building. For indoor use dipped lamps are used, and for outdoor installations color caps. The appeal of this



THE TOLEDO COMPANY'S "BEST SELLER" SIGN. THE DEMAND FOR THIS DISPLAY IS AS WIDESPREAD AS ITS APPEAL

sign is universal. It may be sold for use in lodges, schools, churches, public buildings, hotel lobbies, cafés, stores, or, in fact, in any place where it would be appropriate to float "Old Glory." Including the price of hanging, of lamps and of other accessories, these signs are being sold at $40 for inside decoration and $50 for outside service.

Campaigning from the Hotel—A Way to Reach the Community Where the Central-Station Has No Office

In the towns of Atlanta, Cohocton, Wallace, Avoca, Sodus, Marion and Ontario in northern New York State, and in several nearby villages, practically two-thirds of the unwired houses were connected for electric service in a recent wiring campaign. The Wayne Power Company made a special offer for a limited period and injected a strong personal element into the effort by sending a special representative, E. R. McMurtie, to each town in turn and advertising his presence at the hotel. These places vary in size from 300 to 1700.

"During his sojourn" in each village, so the "ads" ran, there was to be a very special price offer of $7 for wiring houses, including the installation of a premium flatiron. On this plan a meter board was furnished containing the entrance box, fuses, switch and two outlets, one provided for the flatiron, the other for a lamp or extension. This very low price naturally created a good deal of interest and served to educate the people to the fact that they could have their houses connected for electric service at practically any figure they cared to pay, this depending on the extent and standard of the installation. A canvass on this seven-dollar offer was made before the main wiring campaign started, and, acting on the results of this investigation, G. R. Mills, president of the Wayne Power Company, organized the campaign.

Marking the Vehicle "Electric"

There is one feature of the vehicle shown in the accompanying picture that commends itself immediately—not the special Electrical Prosperity Week float display, but the lettering "Electric Wagon" so conspicuously visible beneath the driver's seat. This vehicle is one of the fleet of the Southern California Edison Company of Los Angeles, and has been plainly marked as an "electric" for the benefit of the men and women who are not familiar with the physical distinctions between electric and other motor vehicles.

A LOS ANGELES CENTRAL-STATION TRUCK MARKED "ELECTRIC WAGON"

Electricity Produces Both Heat and Cold in Cold-Storage Plant

When the Tri-City Ice Company of Moline, Ill., took a contract for storing apples in its cold-storage house the problem of maintaining an even temperature of 33 deg. Fahr. presented itself. In warm weather circulating brine, of course, cooled the rooms; but for extremely cold weather provision had to be made to supply a small amount of heat because the insulation of the storage rooms is not entirely radiation-proof. Heating the circulating brine was first considered, but a little further investigation showed that electric heat would be cheaper. Accordingly three 1500-watt open-coil heaters were purchased and installed in delta on the three legs of a three-phase power circuit. Installation of these three heaters presented much less difficulty than would that of a brine heater, and since the ice company was already purchasing large quantities of electric power for its ice machinery, the energy was obtainable at a low rate.

Features of the Milwaukee Rate Schedule—An Active-Room Rate, with Energy Charges of 11, 5 and 2 Cents per Kw.-Hr.

To customers signing the Milwaukee (Wis.) Electric Railway & Light Company's standard form of contract for residence electric service a primary charge of 11 cents per kilowatt-hour for the first 4 kw.-hr. consumed per month is made for each of the first four active rooms. Eleven cents per kilowatt-hour is also charged for the first 2.5 kw.-hr. consumed per month for each active room in excess of the first four. Up to a total of 7 kw.-hr. consumed per active room a secondary charge of 5 cents per kilowatt-hour is made for monthly consumption in excess of that paid for at the primary rate. For all monthly consumption in excess of 7 kw.-hr. per active room the tertiary charge is 2 cents per kilowatt-hour.

In determining the number of active rooms, all rooms, whether containing lamps or not, are counted, except the following: three rooms (which are primarily used or may be used as bedrooms, including therein finished attic or garret rooms), bathrooms, basements, garrets, closets and porches. The foregoing rates include free renewals of tungsten lamps in sizes of 40 watts and larger, and are subject to a prompt-payment discount of 5 per cent on the first $25 of monthly bills and 1 per cent on amounts in excess of $25. The minimum monthly charge is 50 cents. The residence rate includes service used for lamps, motors, heating appliances, battery-charging outfits and equipment of all kinds which does not affect the company's voltage regulation.

With this rate in effect the company is making a campaign on electric cooking. It is estimated that practically all energy over and above that used for illumination and general purposes will be purchased at 2 cents per kilowatt-hour, in spite of the fact that 40-watt lamps may be renewed gratis. As a tertiary rate on a residence schedule 2 cents per kilowatt-hour is lower than is found in most cities.

Another feature in connection with the rate is the effect produced by the clause governing the counting of active rooms. Because of the proportionately greater number of active rooms possessed by a large house as counted under the provisions of this clause, the mansion owner generally pays a comparatively higher average rate per unit of electricity than the tenant of the small apartment. This arrangement of the schedule will, it is thought, tend to encourage the use of household appliances and electric ranges among all classes of customers.

Station and Operating Practice

A Department Devoted to the Problems of Installation, Operation and Maintenance of Equipment for the Economical Generation and Distribution of Electrical Energy for All Uses.

SUBSTITUTING COPPER FOR ALUMINUM

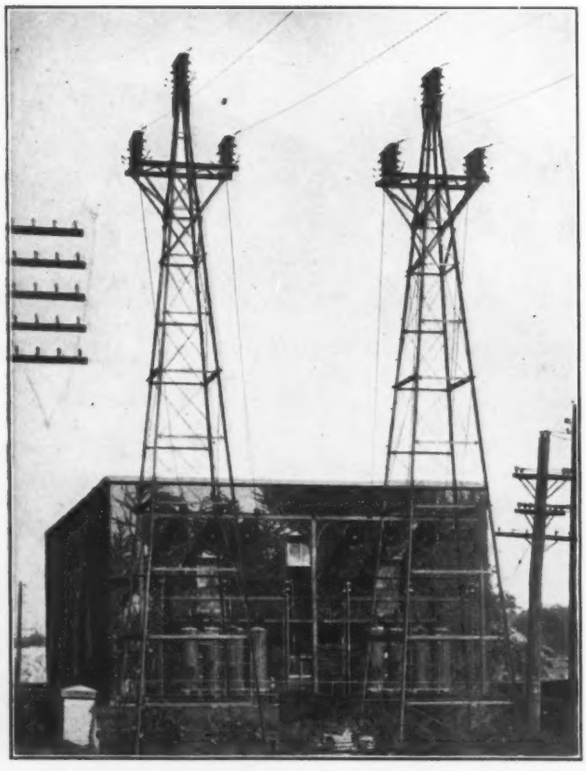
How the Rochester (N. Y.) Railway & Light Company Has Saved $8,400 by Changing Conductors on a 2.2-Mile Line

Arrangements have been made by the Rochester (N. Y.) Railway & Light Company to substitute No. 0 stranded copper wire for the 428,000-circ. mil stranded aluminum conductors of a duplicate three-phase transmission line between Mortimer, N. Y., and the city of Rochester. This line brings twenty-five-cycle, 60,000-volt energy from the lines of the Niagara, Lockport & Ontario Power Company at Mortimer to the city limits of Rochester, a distance of about 2.2 miles. At the city limits the voltage is stepped down at the substation shown in the accompanying illustration to 11,000 volts, and the overhead conductors are connected with underground cables.

The transmission line mentioned was built in 1907 and designed to transmit 18,000 hp. The construction as shown in the photograph consists of two single circuits with four-legged steel towers, the conductors being supported by pin-type insulators secured by Mershon ties. The conductors are spaced according to a triangular arrangement, 84 in. apart, with the lower wires approximately 50 ft. from the ground at the towers. The span lengths vary from 415 ft. to 550 ft., with a calculated sag of the aluminum conductors of 24.5 ft. on the long span at 110 deg. Fahr.

The No. 0 stranded copper conductors will be strung on the same towers that are used by the aluminum line with about the same sag. While the economic capacity of the two circuits of the transmission line has been reduced by the change in conductors to about 12,000 hp., this capacity is considered sufficient for future service, since a larger proportion of the energy demanded by the Rochester distribution system is furnished by the company's generating station than originally anticipated. About 9000 hp. is used from this line at present.

With the price of aluminum at 56 cents per pound and copper at 20 cents per pound—the basis on which the substitution was made—a net amount of $8,400 has been realized from 63,000 lb. of aluminum through the change.



SUBSTATION AT ROCHESTER CITY LIMITS, SHOWING INCOMING 60,000-VOLT LINES AND DEAD-END STRUCTURES

Operating Conditions at a Louisiana Oil-Engine Plant

Since the rehabilitation of the municipal generating station at Opelousas, La., operating expenses have been materially reduced and the average gross revenue has been increased more than $150 per month on account of new business secured through better service. Twenty-four-hour service is now being supplied. The revenue from city lighting and pumping is $321 per month, with additional lighting service sufficient to pay operating expenses and enable the city to pay off the debt contracted through purchase of the new equipment at the rate of $450 per month.

The operating conditions have been improved through the installation of one 100-hp. Mietz & Weiss oil engine directly connected to a 100-kva. Fort Wayne alternating-current generator and one 150-hp. oil engine of the same type directly connected to another 100-kva. generator, together with motor-driven centrifugal pumps and an air compressor for pumping water for the city's supply. This equipment has replaced out-of-date simple and compound steam-engine equipments. When the oil engines were installed, the necessary conditions for parallel operation were carefully considered and the superintendent of the plant, A. C. Tours, reports that no trouble has been experienced in operating the generators in parallel during the five-hour periods of maximum load. Hand-controlled levers with which the engines are equipped make it easy for one man to bring the machines into step without delay when synchronizing. The plant requires one engineer and an oiler.

The water for the city supply is raised 42 ft. from a well by an air-lift pump and discharged into a reservoir at the plant. From the plant reservoir the water is pumped into an elevated tank about half a mile away by two motor-driven centrifugal pumps of 35 hp. and 20 hp. respectively. The tank is 120 ft. above the ground and holds 80,000 gal. An average of 200,000 gal. is drawn from the tank per day, with about 300,000 gal. demanded in extremely dry weather. The town has about 4600 people.

Electrical energy is sold on a meter basis at from 10 cents to 7 cents per kilowatt-hour for a demand between 250 kw.-hr. and 350 kw.-hr. and over per month. The minimum charge is 50 cents per month for one-lamp to ten-lamp installations, 75 cents for ten to

twenty lamps, and $1 for all installations of more than twenty lamps. A deposit is required from all new customers sufficient to cover the estimated bill for one month. There is practically no commercial motor load except in summer when fans are used. In December the peak load is around 100 kw. and in midsummer about 60 kw. The total receipts for electric service during fall and winter months amount to about $1,000 per month and about $400 for water-supply pumping. In the spring and summer the monthly revenue is about $800 and $400 respectively. Oil at the plant costs $1.10 per barrel.

A Convenient Rack to Support Control Equipment for Factory Induction Motors

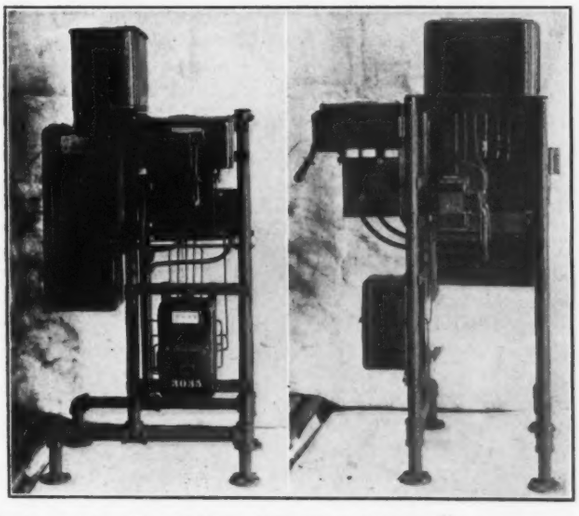
BY H. MATHEWS

It is advantageous in industrial plants to check the energy supplied to the large motors used in any department or operation in order that an accurate cost record may be kept. A watt-hour meter with current and potential transformers is usually necessary. This calls for considerable space, and it is not uncommon to find the equipment arranged on the wall of the building. When installed in this way very little consideration can be given to accessibility and flexibility of the installation or to means for testing the meter equipment or motor.

The arrangement shown in the accompanying illustrations has been devised by an Arizona mining company and is used in connection with its induction-motor drive. The supporting rack is made up of interchangeable parts to accommodate five sizes of starting equipment together with switches, metering and test equipment. The switch and metering equipment may, as desired, have a right-hand or left-hand mounting.

The supports are made up from 1.5-in. pipe with four legs which may be fastened to the floor at the proper location. Five ½-in. bolts are used to hold the frame in alignment, assisted by two ⅜-in. by 3-in. plates used to support the auto-transformer and six ⅜-in. by 1.5-in. bars to support the line switch, current transformers and meter with its test block. In some cases pieces of angle have been used at the back of the rack to support the conduit which brings in the line wires to the motor.

The total weight of the rack as shown in the illustration is about 115 lb., and it supports in the case of the 75-hp. motor equipment which weighs about 600 lb. The floor space required is 5 sq. ft.



FIGS. 1 AND 2—FRONT AND SIDE VIEWS OF A RACK TO SUPPORT MOTOR-STARTING AND METERING EQUIPMENT

Reducing Maintenance Cost in Boiler Furnaces

BY CHARLES M. CREWE

The firebrick lining at the side walls in a coal-burning furnace in the region included between the level of the grates and fire line is a section of a furnace which requires constant attention and repairs. After using standard methods of installing firebrick and trying out special blocks and tiles with different fireclays and mortars, the writer has devised a method of construction which has given five years of service with no expense for repairs.

It is generally recognized that the main cause of deterioration of furnace lining is high temperature, resulting in fusing of brick. Other causes include contraction and expansion with changes of temperature,

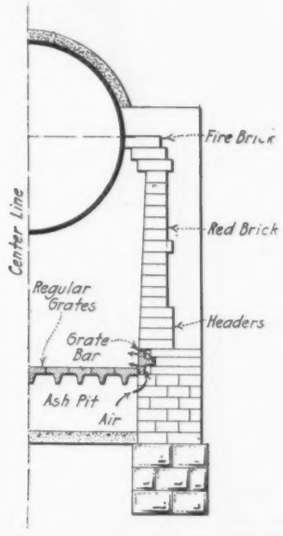


FIG. 1—SECTION OF FURNACE SHOWING SPECIAL SIDE-WALL CONSTRUCTION

the scarifying action of slag and clinkers, and abrasion from fire tools. In the last case pieces of firebrick are broken off in attempting to knock off clinkers which form.

A furnace construction and the method of installing firebrick to overcome this trouble are shown in the accompanying illustrations. In the construction indicated two discarded herringbone grate bars 6 in. wide with ⅜-in. air spaces were used, one at each side wall. These grate bars were set so as to bring the face of the grate flush with the firebrick lining. A heavy type of grate bar is required, and to prevent warping and burning out the lower edge is set slightly below the top surface of regular grates and rests on a checker-work of brickwork opening into the ash pit. This construction allows air to pass in around the back of the grate bar from the ash pit, then through the grate bar into the furnace. In case there is a difficulty in procuring bars of the proper length, two grate bars can be used by placing them end to end.

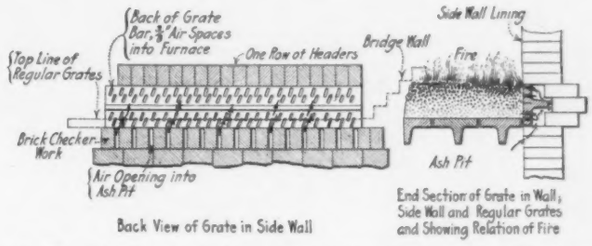

Back of Grate Bar, ⅜" Air Spaces into Furnace
Side Wall Lining
Bridge Wall
Top Line of Regular Grates
One Row of Headers
Fire
Brick Checker-Work
Ash Pit
Air Opening into Ash Pit
Back View of Grate in Side Wall
End Section of Grate in Wall, Side Wall and Regular Grates and Showing Relation of Fire

FIG. 2—BACK OF GRATE USED IN SIDE WALL, SHOWING AIR CIRCULATION THROUGH IT

The firebricks are laid according to a header arrangement directly over the bar and well above the fire line. The lining is then finished in the regular way by laying five rows of bricks as stretchers, then a row as headers, making every seventh row headers.

When the fire is being cleaned the face of the grate bar so installed takes all the wear resulting from the use of slice bar and hoe, and if properly placed little difficulty will result from clinkers. In the writer's case it has been noticed that, while cleaning, the clinkers show no tendency to attach themselves to this surface. The only precaution necessary is to favor the sides of the fire box with extra fuel directly after cleaning and while the fire is light in order to prevent an excess of air over the fire.

The writer has found that this construction operates like regular grates; that is, if kept covered there is little tendency for them to burn out. There will be, however, a certain amount of combustion taking place along the face while the fire is new, due to air coming through from the ash pit. When the fire has thickened sufficiently, the ashes come in contact with this construction, which, together with the air that filters through, forms a protection.

Design and Operation of Horn-Gap Fuses

BY E. P. PECK*

The article on the design and operation of horn-gap fuses by E. A. Dillard in the Dec. 11 issue of the ELECTRICAL WORLD, pages 1305-1307, takes up a subject of vital interest to operating engineers. The writer has experienced troubles with horn-gap fuses and with fiber tubes similar to those reported by Mr. Dillard; however, by spacing the fuses on different phases sufficiently no trouble from short-circuit due to the arc overlapping has been experienced. Extensive tests have been made with various metals and alloys as fuses, with the result that copper has been adopted as the best available metal to use.

The practice of the Georgia Railway & Power Company is to put in fuses which will not blow at less than four times the full load on the transformer bank. The purpose of the fuse in this case is to disconnect the transformer bank from the line so that the operation of other customers will not be affected. The fuse, therefore, offers only partial protection to the transformer bank, so that fuses or circuit-breakers must be used on the secondaries. Since our transformer banks are scattered over a large territory, heavy fusing has been found necessary to prevent a large number of long-time interruptions to customers which would occur if the transformers were fused in accordance with any other scheme.

TABLE I—FUSE SIZES FOR PRIMARIES OF POWER TRANSFORMERS

Single Transformer, Kva.	Bank of Three Transformers, Kva.	11,000 Volts			22,000 Volts		
		Load, Amp.	Fuse, Amp.	Copper Wire, B. & S. Gage No.	Load, Amp.	Fuse, Amp.	Copper Wire, B. & S. Gage No.
50	150	7.8	30	24	4.0	15	26
75	225	11.8	45	22	5.9	25	24
100	300	15.7	60	20	7.8	31	24
150	450	23.5	94	18	12.0	48	22
200	600	31.5	126	16	16.7	67	20
250	750	39.5	158	14	19.7	79	18
300	900	47.2	189	14	23.5	94	18
350	1050	53.0	212	12	26.7	107	16
400	1200	63.0	252	12	31.5	126	16
500	1500	78.7	313	10	39.5	158	14
600	1800	94.5	376	9	47.2	189	14
700	2100	110.0	440	8	53.0	212	12
800	2400	126.0	504	7	63.0	252	10
900	2700	142.0	518	7	71.0	284	10
1000	3000	157.0	628	7	78.7	313	10

When fusing a branch line where it taps a main line, use a fuse at least one size larger than the largest customer's fuse. In no case should the branch line fuse be smaller than No. 14 copper wire for 11,000 volts and No. 18 copper wire for 22,000 volts.

*Superintendent of the department of tests and repairs, Georgia Railway & Power Company, Atlanta, Ga.

TABLE II—FUSING CURRENT OF COPPER WIRE

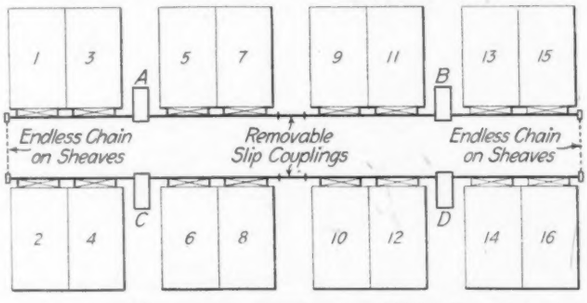
Size Wire, B. & S. Gage No	Amp. to Fuse	Time, Seconds
20	59	9
18	80	12
16	125	12
14	166	17
12	232	27
10	325	33
8	450	36

In Table I the sizes of fuses used with transformers are given. This table is furnished to all linemen, troublemen and construction men, and they are instructed to follow it when placing fuses on transformer banks.

The laboratory tests that we have made to determine the time required to blow a fuse show that the time element is of great importance in determining the proper fuse to use. Table II gives the fusing current and time for wires at the ratings which have been adopted by the writer's company. It will be noted that the minimum time in this table is very much greater than that recommended by Mr. Dillard, who gives as a maximum six-tenths of a second for fuses. With a fusing time as short as this, the current is so many times larger than the current required to fuse the same wire in from ten to twenty seconds that the fusing point of the wire based on the one-second time is very misleading. The Underwriters' rules on inclosed fuses require that the fuse shall carry its normal current continuously, but that the fuse shall melt at about 25 per cent overload. The ratings adopted by the writer's company do not conform to this rule, but are not very widely different from it, whereas if the fusing time were taken at one second or less the fuse would have to be of a size such that its rating would be many times the normal current through the fuse.

Modification of Stoker Drive Which Increased Reliability

For a plant where the boilers are arranged as shown in the accompanying illustration the Metropolitan Electric Company, Reading, Pa., has devised at least one method of overcoming the difficulties which may arise owing to the breaking down of a group-drive stoker engine. As indicated, each stoker engine used can ordinarily operate four stokers, two on each side. In case any one of the engines becomes inoperative, a coupling can be inserted between the particular group's shaft



SLIP COUPLINGS AND ENDLESS CHAINS TO PREVENT INTERRUPTION OF STOKER OPERATION

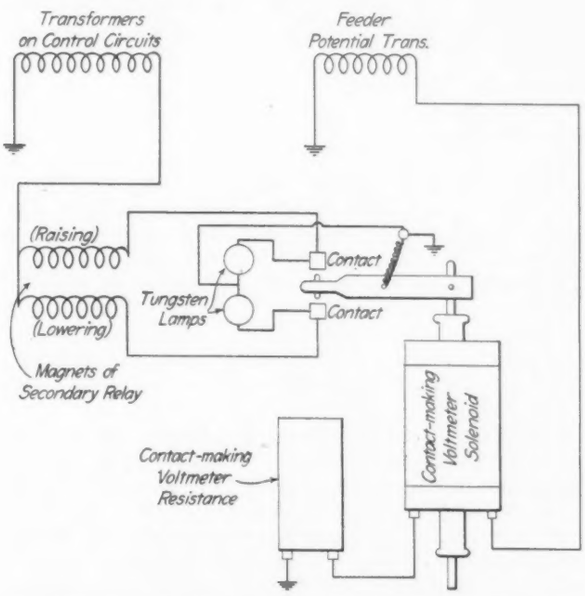
and the adjoining shaft and an endless chain thrown over sheaves attached to shafts opposite each other. In this way the load of the temporarily crippled section will be shared by two engines, which can easily carry 150 per cent normal load. Both couplings are not required if only half the boilers in the disabled group are being operated. The couplings employed between end-to-end shafts consist of bars with slip couplings which allow for changes in the distance between the shafts and for poor alignment. The sheaves which are attached to the ends of the shafts are taken from large chain blocks.

In order that normal conditions may be restored as quickly as possible after a stoker engine gets out of order, a complete extra engine and parts for connecting it with the driving shaft are kept in stock. The reserve engine is loosely assembled so that any part may be quickly removed and substituted for the corresponding part on a disabled engine. When necessary, the entire engine may be substituted for the one which must be removed. Additional precautions have been taken by providing a portable stoker drive which can be set up in front of any shaft in a few minutes.

Tungsten-Lamp Shunt Valuable for Preventing Arcing at Contacts

At the Hicks Street substation of the Edison Electric Illuminating Company of Brooklyn trouble was experienced with excessive pitting of the contacts on a contact-making voltmeter-controlling automatic feeder regulator, owing to the large current taken by the secondary relays. To remedy the difficulty 15-watt tungsten lamps were connected across the contact points. These lamps were selected because of their desirable temperature coefficient.

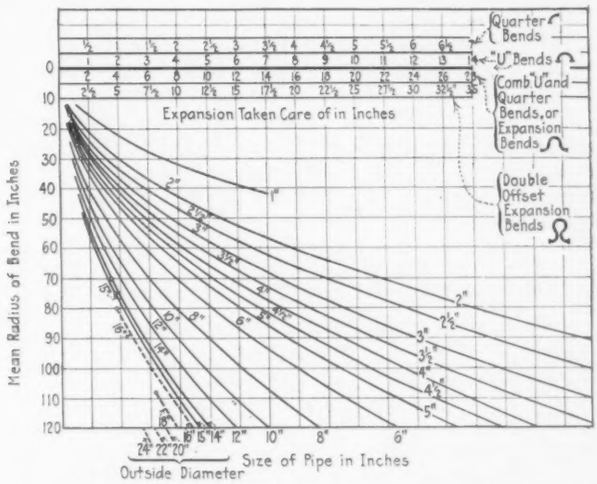
When the contacts are closed and the lamp not lighted the resistance is low (100 ohms), but when the contacts open and the lamp lights the resistance rises to 960 ohms—about ten times its former value. Thus the shunt gradually decreases the current when the contacts are opened so that very little arcing is caused. Furthermore, the lamps consume little energy. The current passing through the lighted lamp is not sufficient to hold the relay.



ARCING AT CONTACT-MAKING VOLTMETER CONTACTS PREVENTED BY SUITABLE SHUNT

Weights of Pipe and Advisable Radii to Employ in Expansion Bends

In laying out pipe lines some provision must be made for longitudinal expansion and contraction of the metal, otherwise the joints may fail or the pipe buckle. This is particularly necessary if a long continuous line of tangent pipe is employed or if the range of temperature to which it is exposed is very great. One method of allowing for the change in length is to substitute bends for straight pieces of pipe. The amount of contraction or expansion which can be provided for in this way can be readily computed from the range of temperature, the length between anchored points, and the longitudinal expansion coefficient for the particular metal. To deter-


Quarter Bends
"U" Bends
Comb U and Quarter Bends, or Expansion Bends
Double Offset Expansion Bends
Expansion Taken Care of in Inches
Mean Radius of Bend in Inches
Outside Diameter
Size of Pipe in Inches

CURVES TO DETERMINE TYPE AND RADII OF BENDS TO TAKE CARE OF PIPE EXPANSION AND CONTRACTION

mine what type or radius of bend is required the accompanying curves will be found useful. They are based on data compiled by the Crane Company of Chicago.

The allowable expansions indicated by the curves are for standard and extra heavy-weight wrought-iron and steel pipe bends with an allowable fiber stress of 15,000 lb. per square inch. The small circles appearing on the curves show the minimum radius which should be used for bends. If the bends are sprung in the opposite direction to the movement for which they must compensate, they can be used for double the expansion indicated. By connecting several small-diameter pipes in parallel to headers it is possible to get more expansion in small space than with a single bend. Care must be taken, however, to provide sufficient aggregate cross-section. When using lap-welded steel pipe the radius

TABLE I—WEIGHT OF PIPE TO USE WITH DIFFERENT RADII OF BENDS, SIZES OF PIPE AND WORKING PRESSURES*

Size of Pipe (Diameter), Inches	0-125 Lb. Pressure		125-250 Lb. Pressure		250-350 Lb. Pressure
	4 to 5 Diameter	Over 5 Diameter	4 to 6 Diameter	Over 6 Diameter	4 Diameter and Over
7 and smaller	Extra strong	Full weight	Extra strong	Full weight	Extra strong
8	0.5-in. thick	28.55 lb. per ft.	0.5 in.	28.55 lb.	0.5 in.
10	0.5-in. thick	40.48 lb. per ft.	0.5 in.	40.48 lb.	0.5 in.
12	0.5-in. thick	49.56 lb. per ft.	0.5 in.	49.56 lb.	0.5 in.
14 to 16	0.5-in. thick	$\frac{5}{16}$ in. thick	0.5 in.	$\frac{5}{16}$ in.	0.5 in.
18 to 22	0.5-in. thick	$\frac{3}{8}$ in. thick	0.5 in.	$\frac{7}{16}$ in.	0.5 in.
24 to 30	0.5-in. thick	$\frac{7}{16}$ in. thick	0.5 in.	$\frac{1}{2}$ in.	0.5 in.

Recommended by the Crane Company.

TABLE II—LENGTHS OF TANGENTS TO USE WITH BENDS MADE OF DIFFERENT SIZE PIPE*

Sizes of Pipe, In.	Length of Tangent, In.	Sizes of Pipe, In.	Length of Tangent, In.
2.5 and 3	4	6, 7, 8, 9, 10, 12, 14, 15	16
3.5 and 4	5	7, 8, 9, 11, 12, 14, 16 to 30	18
4.5 and 5	6	....	..

*Recommended by the Crane Company.

of the bends should be at least five times the diameter of the pipe when using anything up to and including 16-in. pipe, whereas bends made of larger pipe should have a radius equal to six times the diameter.

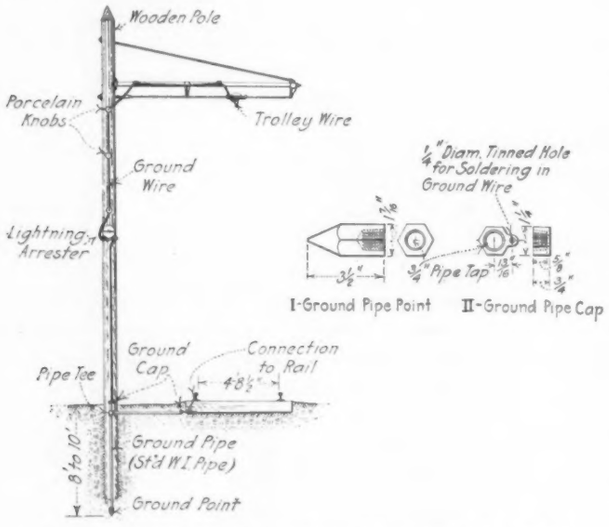
Tangents or straight parts are necessary at the ends of pipe bends to facilitate making perfect flange joints. Bends are superior to loops made of straight pipe and fittings because the former are more flexible and do not throw all the load on the joints.

After ascertaining the radius of bend to use for a certain purpose, attention should be paid to the weight of pipe required. This information and the length of tangents necessary are given in the accompanying tables.

A Convenient Point and Cap for Ground Pipes

The accompanying illustrations show a use of ground-pipe point and cap castings in making serviceable ground connections. The point is of galvanized malleable iron and the cap is of brass. The hole in the lug is tinned so that the ground wire can be soldered into it. When installing this device the point is screwed on the ground pipe, which is then driven into the earth to a depth of 8 ft. or 10 ft. The cap is then screwed on and the ground wire soldered into it. In driving in the ground pipe, a coupling should be run on the thread on the top of the ground pipe in order to prevent its mutilation.

Where it is inconvenient to drive the ground pipe into the earth in one length, it can be divided in two lengths. The first is driven in and then the second is joined to it with an ordinary pipe coupling. Where it is desirable to limit the possibility of tampering with the ground wire where it joins the upper end of the ground pipe, the ground pipe can be extended for a distance of about 8 ft. from the surface of the earth up the side of the pole.



POINT AND CAP CASTINGS DESIGNED FOR USE WHEN MAKING GROUND CONNECTIONS

How Transmission-Line Conductors Should Be Attached to Their Supports

BY R. D. COOMBS

While proper consideration of the strength of conductors and their supports is imperative if a transmission or distribution line is to furnish uninterrupted service, it is of little avail if the conductors are not properly fastened to their supports and the insulators made secure against normal and probable loads. Conductors are usually fastened to the insulators to prevent falling and creeping rather than for dead-ending. Tie-wires should be made of the same material as the conductors they grip to prevent electrolytic action, and should be soft so they will not spring loose after tightening. It is preferable to obtain the friction required by a number of closely wrapped turns extending over a long surface rather than to employ a few turns, which may injure the conductor. Stranded cables can be tied most effectively because the tie-wires can be made to lie in between the strands.

Loop cables equipped with clamps can be employed to dead-end conductors to pin-type insulators. The loop should be placed over the neck of the insulator and the end clamped to the conductors with three-bolt clamps or several clips. Care should be taken not to tighten the clamps excessively, otherwise they may injure soft-drawn cables. A few tests on loop cables have given the following results: (1) A loop cable made of 250,000-circ. mil soft copper directly attached to a testing machine failed in the loop splice at 7200 lb.; (2) a similar loop cable connected to a conductor with Crosby clips began to slip at 2900 lb., and continued tightening of the clips cut the strands of the cable; (3) a loop of 0.5-in. steel failed at 9800 lb.

High-voltage long-span lines should be spliced with splicing sleeves or special connectors, as the conductivity and mechanical strength may be maintained more satisfactorily thereby. Medium or hard-drawn material should not be soldered or subjected to sharp bends, because the temper may be drawn or the material cracked.

Few if any single pin-type insulators are suitable on sharp turns in lines, especially with large conductors, as deflection of the pin may allow the conductor to slip off the insulator. Larger pins are desirable, but the insulators would have to be specially designed for them. Double cross-arms will not necessarily give desired results. Pins should be tested after they are inserted in the insulators to determine the amount of deflection under load. There may be reasons for specifying certain strength for pin-insulator supports, but on tangent they need never withstand the stress developed by a broken wire, as the tie-wire will seldom transmit the load. At sharp corners it is preferable to use disk or suspension-type insulators since they transmit the load directly to the cross-arm without the torsion caused by a tall pin.

Through-pin insulators may be employed at turns in a line for pressures under 20,000 volts, although such insulators are made with ratings up to 30,000 volts. The pins used with this type, being made of rolled-steel rod, are not liable to bend and crack the porcelain; they act as a simple beam rather than as a cantilever. Interlocking strain insulators of the goose-egg type provide great mechanical strength and retain some usefulness after failure as the wires interlink. Such insulators do not have as high electrical factors of safety, however, as the disk type. The insulation of guys on poles carrying high-voltage wires is undesirable from a structural viewpoint, although it may be advisable in order to protect pedestrians in cases where wooden poles are employed.

Technical Advance in Theory and Practice

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Bearings of Electrical Machinery.—An abstract of a paper by Andrew Gibson before the West of Scotland branch of the (British) Association of Mining Electrical Engineers on bearings of electrical machinery. The oily or greasy film between the shaft and the bearing seems to act in the same way as a great number of metallic balls would, by supporting the load and keeping the surfaces apart. The break-down of this film allows the surfaces to come together, and the consequent metallic friction, producing heat, to all intents and purposes welds the two surfaces together. The load at which this occurs depends chiefly upon the viscosity of the oil, in which temperature plays an important part. The thicker and less free-flowing an oil is, the greater unit pressure it will stand in a bearing without squeezing out. A very light spindle oil, for instance, will stand, say, a pressure of about 50 lb. per square inch, whereas a cylinder oil of good body will stand a pressure of over 2000 lb. per square inch on the same bearing. Therefore the unit pressure which any bearing will stand depends chiefly upon the lubricating film, which in turn is influenced by the arrangement of the bearing surfaces. The allowance commonly made for the running fit of the bearing and shaft is about 0.0005 $(D + 1)$, where D is the nominal diameter of the shaft in inches. Some manufacturers of fast-running machinery make the diameter of the bearing exceed that of the shaft by nearly twice that amount. This clearance allows the shaft to take up an eccentric position in the bearing, leaving a space on the side from which the load is applied. It is at this point that the lubricant should be introduced, so as to spread itself upon the shaft, adhere to it, and travel round upon the surface, being forced between the bearing surfaces at the pressure necessary to support the load. The cutting of oil grooves in bearings is a matter requiring extreme care and attention, as a groove placed where the oil is under pressure would act merely as a collector for the oil and provide it with a path of escape before it had accomplished its purpose. As much thought and care should be given to the grooves as to the rest of the bearing, and it should be kept in mind that their function is to distribute the oil between the bearing and shaft where the load is not supported. With regard to ball bearings, the author pointed out that these fulfill the condition of reducing friction to the lowest possible amount, and better, perhaps, than any other type, but there are certain disadvantages with them. The principal one seems to be delay in the working of the machine if repairs have to be made to the ball bearing. Nevertheless, there is a growing demand for them for all classes of machinery because of their free-running properties and the small amount of attention required to maintain them. An important point is to have self-aligning ball bearings, because a bearing which cannot adjust itself to suit the shaft requires extreme accuracy in fitting up, and the least inaccuracy in alignment and housings results in wedged and broken balls and abnormal wear. —London *Elec. Eng'ing*, Dec. 2, 1915.

Lamps and Lighting

A Precision Artificial Eye.—HERBERT E. IVES.—The most attractive solution of all problems of measurement which depend upon the characteristics of a normal or average eye is to embody these characteristics in some entirely physical instrument. The author formerly described a thermopile artifical eye, which, however, had certain objections. He has now developed a thermopile

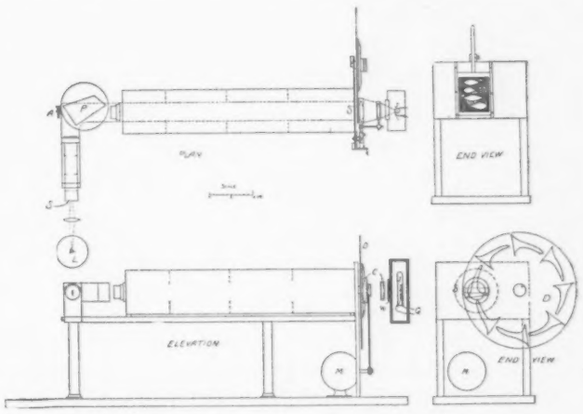


FIG. 1—DIAGRAM OF THERMOPILE ARTIFICIAL EYE

artificial eye that is not open to these objections. It is a precision instrument in the sense that any wavelength sensibility curve may be exactly copied. Once the instrument is constructed the labor of copying additional curves of any type is comparatively trivial. The apparatus is a modification of the apparatus for the spectroscopic synthesis of color. It consists essentially of a spectrometer forming a spectrum which is passed through a templet and then combined upon a sensitive thermo-junction. By means of templets of various

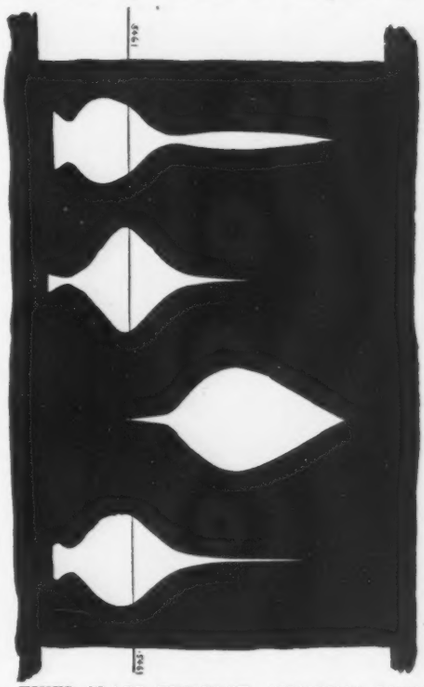


FIG. 2—FIXED-GLASS TEMPLET, SHOWING LUMINOSITY AND SENSATION CURVES

shapes the radiation may be evaluated in any desired way, as luminous flux, as red, green or blue sensation, etc. Fig. 1 exhibits diagrammatically the complete apparatus. The image of a filament or extended light source *L* is formed on the slit *S* by means of a lens. A spectrum of this is formed by the prism *P* at *S'*. Over this spectrum is a templet, which may be in the form of a rotating disk or which may be a flat stationary plate. Close to the templet is a lens or lens system, the function of which is to recombine the spectrum, forming an image of the prism face in the color of the recombined light upon the thermo-junction *J*. In order to get a sufficient degree of sensibility, it is important to make the intrinsic sensitiveness of the thermo-junction as high as possible. For this reason the author uses a BiSn-BiSb thermo-junction of the evacuated type. The first templet tried was in the rotating-disk form, shown in Fig. 1 at *D*. This was cut to the visual luminosity curve, correcting for the absorption of the prism. Later a fixed-glass templet was developed. Fig. 2 shows the latter. It has upon it the luminosity curve of the spectrum at the top, and below, in order, the red, green and blue Koenig sensation curves. This glass templet is mounted with adjustable clamps upon a brass frame sliding in accurate tracks, as shown in Fig. 1 in the upper "end view." In addition to the measurement of relative luminosities, this instrument may be used for color measurement by the three-color system. It is necessary only to have three templets, each cut to represent the mixing proportions throughout the spectrum of one of the chosen primaries and measure the relative deflections through these. The logical primaries to choose are the fundamental sensations, for instance, as determined by Koenig. Various practical applications of this instrument are discussed.—*Phys. Review*, November, 1915.

Filament Temperature of Electric Incandescent Lamps.—M. PIRANI AND A. R. MEYER.—The authors give a summary of recent measurements by different investigators of the temperature of the filaments of

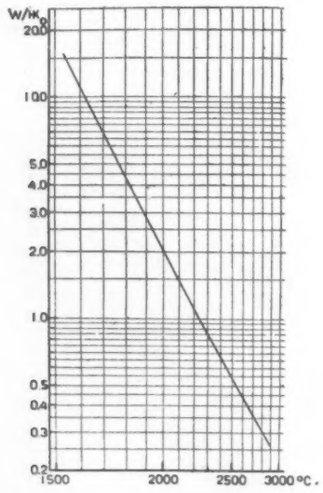


FIG. 3—RELATION BETWEEN WATTAGE AND FILAMENT TEMPERATURE

various types of incandescent lamps as a function of the specific power consumption. They show that for practical purposes these figures are known with a sufficient accuracy. It is evident, however, that figures of this kind are of practical importance only if they represent mean values of measurements of a large number of well-defined and properly aged lamps of identical construction. The authors add some measurements of their own of nitrogen-filled "half-watt lamps" of large sizes, relating to lamps of 1000 cp. to 3000 cp. at 110 volts. The results are given in the accompanying table, where the third column (I) gives watts per maximum (i.e., mean horizontal) hefner candle-power for nitrogen-filled "half-watt lamps" with the tungsten-filament spiral arranged in zigzag form, and the fourth column (II) gives the watts per maximum (i.e., axial) hefner candle-power for half-watt lamps with the tungsten spiral filament arranged in ring form. Fig. 3 shows diagrammatically the relation between the watts per

TEMPERATURE OF INCANDESCENT-LAMP FILAMENTS

Watts per Mean Spherical Hefner Candle	True Filament Temperature in Deg. C.	I	II
10.0	1615	9.0	8.0
5.0	1770	4.5	4.0
4.0	1820	3.6	3.2
3.0	1890	2.7	2.4
2.0	2005	1.8	1.6
1.0	2240	0.9	0.8
0.8	2325	0.72	0.64
0.6	2450	0.54	0.48
0.5	2535	0.45	0.40
0.4	2650	0.36	0.32
0.3	2815	0.27	0.24

mean spherical hefner candle-power and the true filament temperature in degrees C. for 1000-cp. to 3000-cp., 110-volt "half-watt lamps."—*Elek. u. Masch.* (Vienna), Aug. 15, 1915.

Generation, Transmission and Distribution

Norwegian Water-Power Plant.—J. REYVAL.—An illustrated description of the water-power plant supplying energy to the Vigeland aluminum works near Vennesla in Norway. There are four turbines, each of 3000 hp. and each coupled to a direct-current 2000-kw. generator. Each generator, running at 220 r.p.m., supplies 8000 amp. at 250 volts. It is provided with interpoles but has only one commutator. Each generator supplies thirty-five electrolytic furnaces, each being operated at 7 volts. The annual output is 2000 tons of aluminum.—*La Lumière Elec.*, Sept. 25 and Oct. 2, 1915.

Electrophysics and Magnetism

Alpha Rays in Hydrogen.—J. C. MCLENNAN AND H. V. MERCER.—When alpha particles from radium are projected into hydrogen, velocities are given to particles of the gas which enable them to pass through a thickness of aluminum foil capable of stopping the fastest alpha particles. The authors have undertaken an experimental study of the ionization tracks of alpha rays in hydrogen. The chief results are as follows: Although alpha-ray tracks in hydrogen are of greater length than those in air, they exhibit similar characteristics to those obtained in air. Alpha-ray ionization tracks can be exhibited by the condensation of alcohol vapor quite as well as with the condensation of water vapor. Apart from the crooks at the ends of the alpha-ray tracks, the "scattering" is due to single deflections through considerable angles. The experiments failed to bring out evidence in support of ionization by the nuclei of hydrogen atoms projected from the latter when alpha particles collide with the atoms. The experiments go to show that when alpha particles are projected through hydrogen or through hydrogen containing traces of air exceedingly few collisions occur which result in the ejection of a hydrogen nucleus.—*Philos. Magazine*, November, 1915.

Units, Measurements and Instruments

Precision Resistance for High-Frequency Currents.—KARL WILLY WAGNER.—The first part of an investigation carried out in the German Reichsanstalt. The

author first deals with the development and simplification of the method of measuring. The accuracy required is rather high since the time constant of the resistances is to be measured with an accuracy of 0.05 to 0.1 = 10^{-8} second. The substitution method recommended by the author permits of obtaining this accuracy easily, although his arrangement of apparatus is much simpler than former arrangements. A number of standard resistances with known time constants were built, and the influence of the distributed earth capacities on the time constants of these resistances was investigated. When the resistance coils are combined in resistance boxes the time constant is changed on account of the inductance of the connections and the capacities of the contact pieces and the capacities of the coils with respect to each other and against earth. These different effects are investigated and the mutual capacities of the coils with respect to each other are found to have the greatest effect. The article is to be concluded.—*Elek. Zeit.*, Nov. 18, 1915.

Telegraphy, Telephony and Signals

Adjustable Prism-Shaped Multiple Spark-Gap.—B. THIEME.—A translation of a recent paper read before the German Physical Society on methods for overcoming the disadvantages of the usual quenched-spark and explosive gaps for wireless telegraphy. The author uses electrodes in the form of prisms, a regular octagonal prism proving the most practical. Several such prisms are connected in series. By laying the prisms on a plane surface parallelism of the sparking surfaces is secured. When, after long-continued use, the sparking surfaces are eaten away, the whole lot of the active prism surfaces can at once be renewed by the simple expedient of lifting them out of their seating and turning them one-eighth of a revolution (the amount of one face). For the different purposes for which they are to be used the separate prism surfaces can be coated with different materials, the arrangement thus allowing a wide range of adaptability. In cases where the load may be at times very different from that at other times, and if it be not proposed to adjust for such loads by means of short-circuiting one or more of the gaps, the prisms can be made with unequal sides, so that surfaces of greater or smaller area are opposite to one another (for the purpose of securing low spark decrement). For adjusting the sparking distance each pair of prisms is made into a unit, the axes being fastened together though insulated from one another. Each such pair can be interchanged and can be shifted with respect to the other prism units perpendicularly to the axial direction and axial plane. In this way a fine adjustment of the electrode-separating distance is obtained by mechanical means in a very simple manner, so that in order to attain the lowest possible damping the length of the separate spark-gaps can be shortened, even while sending is being carried on, to near the limit of the quenching action.—London *Electrician*, Nov. 5, 1915.

Classification of Alternating-Current Motors

BY PROF. C. A. ADAMS, CHAIRMAN A. I. E. E. STANDARDS COMMITTEE

The writer has been asked to summarize the discussion that has been going on in these columns under the caption "What to Call Alternating-Current Motors" (Aug. 14, Oct. 30, Nov. 6 and Dec. 18).

As in the case of the other work of the standards committee, the principal end which it is desired to attain in this instance is to agree upon a language, as simple and at the same time as distinctive as possible, which will be understood by all. In a use of this kind the language includes not only words but also diagrams, both schematic and vector.

If the present discussion has demonstrated any one thing more clearly than another, it is the need of such a common language, since a considerable part of the apparent difference of opinion is undoubtedly due to lack of understanding of the other fellow's language.

Another large source of this difference of opinion is the difference in the points of view from which the various writers have approached the various parts of the subject. This is most pronounced in connection with the use of the term "repulsion" motor, as the scientific appropriateness of this term seems to the writer to depend wholly upon the direction of approach. For example, any direct-current motor may be called a "repulsion" motor if one considers its operation as due to the repulsion of the armature poles by the field poles of like sign, or an attraction motor if one looks upon the operation as due to the attraction of the armature poles for the field poles of unlike sign.

The real questions which must be answered in this connection are: (1) Is the term "repulsion" motor so intrenched in common usage that any effort on the part of the standards committee to abolish it will prove futile? (2) If not, is it an otherwise desirable term? (3) If so, what is a suitable definition of it? If it is to be used permanently, it should certainly have a clearly distinguishing definition based upon fundamental rather than superficial characteristics.

It appears from the discussion to date that it will be very difficult to agree on a broad and comprehensive nomenclature at this stage of the art. If this proves the case, it is to be hoped that any names that are agreed upon for the more common or commercial forms of alternating-current motors will be such that they can be readily extended according to a rational system of classification.

However, apart from the names of the various types of motors themselves, there remains the important work of defining what may be called auxiliary words, such as "neutralizing" or "compensating," and here there seems to be a strong probability that agreement can be reached without serious difficulty.

Another field which might well be covered is that of conventions and symbols used in the diagrams of various sorts. This is not at all an unimportant matter. At present a considerable part of the effort involved in understanding the description of a new type of commutator motor is in learning the graphical as well as the verbal language of the author or inventor. This often requires great acrobatic ability, as one must be able to stand on his head and turn himself inside out before the diagram looks natural. Mr. Fynn's suggestion in this line should certainly prove helpful to those interested.

It is hoped that these few suggestions will help to focus future discussions on what seem to be profitable fields. On behalf of the standards committee, the writer wishes to thank most heartily those who have already contributed to the discussion, particularly the authors of the two original papers, and to urge all interested in the subject to send in their views, whether or not they have already contributed to the discussion.

John M. Cowle has been appointed assistant electrical engineer of the Buffalo (N. Y.) General Electric Company.

Henry Morgan has resigned as secretary and assistant treasurer of the United Gas & Electric Corporation, New York City.

M. D. Evans has been appointed secretary and assistant treasurer of the United Gas & Electric Corporation of New York City.

G. D. Henderson, formerly of Hopkins, Mo., has purchased an interest in the Chandler Electric Company of Chandler, Okla., and will take charge there Jan. 1.

B. M. Atkins of the North Coast Power Company of Vancouver, Wash., has been appointed district manager of the company. The district office has been removed from Kalama to Kelso.

George W. Hanna has been appointed sales engineer for the Willard Storage Battery Company, Cleveland, Ohio. Mr. Hanna was until recently assistant to the sales manager of the company.

Frederick W. Ballard of Cleveland, Ohio, has been retained by the city of Philadelphia to assist in the new appraisal about to be made of the property of the Philadelphia Electric Company.

L. H. Harris, associate professor of electrical engineering in the University of Pittsburgh, Pittsburgh, Pa., has been appointed assistant secretary of the Society for the Promotion of Engineering Education.

W. P. Byron, the newly elected president of the Nebraska Section of the N. E. L. A., is vice-president and general manager of the Gothenburg (Neb.) Light & Power Company. Besides his activity in central-station work, Mr. Byron also manages a large cattle ranch of 50,000 acres with a herd of 5000 head of cattle and is interested in an irrigation canal company supplying about 80 miles of irrigating ditches. The new president has for years labored early and late for the advancement of the electrical interests of the State, and at the recent meeting held in Omaha he was unanimously elected head of the Section. Mr. Byron is a native of Illinois and will be fifty years old next February.

W. P. BYRON

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Donald Earl Bent, recently of the Missouri Valley Light & Power Company of El Dorado Springs, Mo., has purchased and assumed the management of the La Plata Light, Heat & Ice Company of La Plata, Mo.

C. O. Baird has resigned as switchboard engineer of the Fort Wayne Electric Works of the General Electric Company, Fort Wayne, Ind., to become connected with the F. Bissell Company of Toledo, Ohio, as machinery specialist.

Charles E. Burgoon has resigned as inspector of mechanical and electrical engineering for the Panama Canal, Washington, D. C., and has been appointed chief mechanical and electrical engineer of the Carbolite Chemical Company at Copper Hill, Tenn.

Thomas Cheyne of Paterson, N. J., has been appointed vice-president of the Reading (Pa.) Transit & Light Company, with headquarters in Reading. Mr. Cheyne will also be assistant to E. W. West of New York City, the new president and general manager, who took charge Nov. 1.

John M. Atkinson, Jr., who for the last two years has been manager of the La Plata Light, Heat & Ice Company of La Plata, Mo., has resigned that position to become manager of the Missouri Valley Light & Power Company and the El Dorado Ice Company at El Dorado Springs, Mo.

W. F. Hoover, general manager of the Tennessee Power Company of Chattanooga, Tenn., was elected president of the Industrial Association of the South at a meeting held recently for the purpose of organizing the new body, the purpose of which is to advertise the resources of the Southern States.

G. Sabin Brush has resigned from the Boston (Mass.) Elevated Railway Company to accept the position of superintendent of the railway department of the Cumberland County Power & Light Company of Portland, Me. In his new position Mr. Brush will have charge of 107 miles of railway, including all the car lines in the city of Portland and adjoining towns.

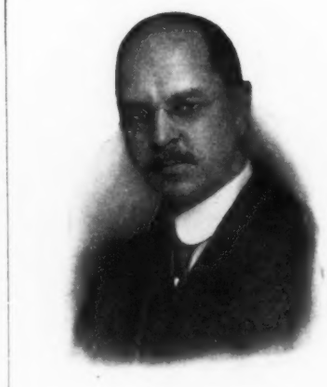
Dr. Michael I. Pupin of Columbia University was elected president of the New York Academy of Science at New York City on Dec. 20, succeeding George F. Kunz. The annual dinner of the academy, held at the Hotel Manhattan, was followed by a joint session by transcontinental telephone with the California Academy of Natural Science at San Francisco.

John C. Humphreys has resigned as superintendent of the Bath (Me.) division of the Maine Water Company and has been succeeded by Walter F. Abbott, assistant superintendent. Mr. Humphreys had been superintendent of the Maine company for the last sixteen years. He will hereafter devote his whole time to his work as superintendent of the Bath & Brunswick Light & Power Company.

Prof. S. N. Williams, after forty-one years of active service at Cornell College, Mount Vernon, Iowa, part of which was served as professor of electrical engineering, has been appointed professor emeritus of the institution and is now living at 221 North Lamon Avenue, Chicago, Ill.

B. G. Tremaine, general manager of the National Electric Lamp Association, Cleveland, Ohio, is receiving the sympathy of his friends and business associates upon the death of his father, Warren Tremaine, who died at the Tremaine home on Euclid Avenue, Cleveland, Dec. 13. The elder Mr. Tremaine was a native of New York, but for the last twenty-five years had lived in Cleveland.

D. W. Roper, who was appointed chairman of the station committee at the recent conference held in New York City in connection with the proposed Safety Code, is superintendent of the street department of the Commonwealth Edison Company, Chicago. After his graduation from Cornell in 1893, Mr. Roper began his electrical career with the National Electric Company of Eau Claire, Wis., afterward resigning to take up the students' course of the General Electric Company at Schenectady. Later he was in station operating work at Niagara Falls, N. Y., and in 1897 he joined the staff of the Missouri Edison Electric Company at St. Louis. After supervising the installation of the underground conduit system and the removal of the overhead wires, Mr. Roper was in 1899 appointed superintendent of electrical equipment, his duties being gradually extended to include the supervision of all electrical construction and operating work. In 1903 Mr. Roper became connected with the old Chicago Edison Company, the forerunner of the present Commonwealth Edison Company, and in 1904 he was appointed assistant to the chief operating engineer, giving special attention to the design, construction and operation of the underground system of the company.



D. W. ROPER

D. E. PARSONS

Delos E. Parsons, who has been appointed general manager of the East St. Louis (Ill.) & Suburban Company, which through its subsidiary, the East St. Louis Light & Power Company, supplies central-station service to the territory just across the Mississippi River from the city of St. Louis, is a graduate of the mechanical engineering school of West Virginia University and of the two-year apprenticeship course of the Westinghouse Company. After serving in the sales department of the Westinghouse organization, Mr. Parsons was in 1906 promoted to the position of head of the export division at the company's works. In 1908 he represented the Westinghouse company at Fairmont, W. Va., for the sale of apparatus to mining companies, and in 1909 he joined the sales force of the railway and lighting department of the company.

J. W. Worthington of Sheffield, Ala., vice-president of the Alabama Power Company of Birmingham, has withdrawn from active detail work for the Alabama company and will hereafter devote his entire time to the advancement of the Muscle Shoals power project. Mr. Worthington expects to spend the greater portion of his time in Washington promoting the Muscle Shoals project as a representative of the Muscle Shoals Power Company, which is owned by the Alabama Power Company.

Ernest E. McCleary, who was the representative of the National Electrical Contractors' Association at the recent National Electrical Safety Code conferences, is a leading electrical contractor of Detroit and is a director and past-president of the association he represented. Mr. McCleary was elected president of the association in 1903, being its second chief executive, and has long been prominent in the councils of the organization. For some years he has also been the contractors' association representative on the electrical committee of the National Fire Protection Association and its predecessor, the Conference on Electrical Rules.

E. E. McCLEARY

Obituary

E. T. Munger, for a time general manager of the Cumberland County Power & Light Company, Portland, Me., died lately at Paterson, N. J., following an illness of several months.

E. D. Martinez, electrical engineer of the Memphis (Tenn.) Street Railway Company, died Dec. 4, of a cerebral hemorrhage. Mr. Martinez was a native of New Orleans and a graduate of Tulane University.

James Stowell Anthony, at one time assistant to the president of the General Electric Company, died at Cannes, France, Dec. 20, at the age of forty-four. Mr. Anthony formerly lived in New York, but moved to France ten years ago.

Leonard A. Jansen, at one time a member of the Milwaukee (Wis.) Board of Public Works and for twenty-five years superintendent of construction for the Milwaukee Electric Railway & Light Company, died Dec. 16, at the age of sixty-nine years.

Ira Miller, one of the pioneers in New England electric-vehicle development and for thirty years a leading business man of Westfield, Mass., died at Little Rock, Ark., on Dec. 16, while en route to Hot Springs. Mr. Miller was born in Cadiz, Ky., sixty-seven years ago. His business interests were varied, and about five years ago he became interested in the electric vehicle, later taking an active part in the work of the Electric Motor Car Club of Boston and representing the Couple Gear Freight Wheel Company of Grand, Rapids, Mich.

William H. Rodier, superintendent of construction of the Safety Insulated Wire & Cable Company, died at Englewood, N. J., Dec. 14, after a brief illness. Mr. Rodier was a pioneer in the installation of underground cables, his connection with the electrical industry having extended over a period of thirty years, and he was the first general foreman in charge of underground work for the old United States Illuminating Company, the predecessor of the present United Electric Light & Power Company of New York City.

W. W. Cole, consulting engineer and member of the firm of Cole, Ives & Davidson of New York City, was found dead in his room in a Poughkeepsie (N. Y.) hotel Dec. 20, death having resulted from asphyxiation by gas. Mr. Cole was forty-eight years of age and a graduate of Worcester Polytechnic Institute, class of 1887. After several years of railroad work in the West, Mr. Cole returned to Boston as electrical superintendent of the West End Street Railroad. From 1892 to 1908 he was associated with the Elmira (N. Y.) Water, Light & Railroad Company as vice-president and general manager. Later he become consulting engineer for Day & Zimmerman of Philadelphia and New York, and in this connection for a time managed the Venango Light & Power Company of Oil City, Pa. Retiring from the Day & Zimmerman organization, he opened a consulting office in New York City in 1914, later becoming a member of the firm of Cole, Ives & Davidson. Mr. Cole was the first president of the Empire State Gas & Electric Association and was a member of the principal national engineering bodies.

W. W. COLE

William Claflin Andrews, advertising manager of the Edison Storage Battery Company, West Orange, N. J., died at New York City on Dec. 21. A graduate of Tufts College, Mr. Andrews afterward entered testing work with the General Electric Company at Schenectady, N. Y., and later went with the Edison Lamp Works of the company at Harrison, N. J. In 1909 he joined the Rae Company as secretary and as business manager of *Electrical Merchandise*, resigning in 1912 to become advertising manager of the Edison Storage Battery Company, the position which he held at the time of his death. Mr. Andrews enjoyed an unusually large acquaintance among electrical men and had been particularly active in the Electric Vehicle Association of America and in the Jovian Order, in which he was statesman for New Jersey.

New Apparatus and Appliances

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Industry

Cable Pot-Heads for Disconnecting and Non-Disconnecting Service

Several types of cable pot-heads designed for either disconnecting or non-disconnecting work and for outdoor or indoor service have been developed by the Philadelphia Electric Company, 132 South Eleventh Street, Philadelphia, Pa. The Franklin cable pot-head, as it is called, consists essentially of three

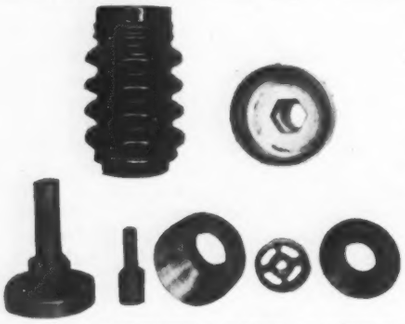


FIG. 1—DISASSEMBLED PARTS OF SINGLE-CONDUCTOR POT-HEAD

parts—the base and clamping member, the body, and the cover and entrance bushing.

The most important feature of the metal base is the inner clamping member, which is constructed so as to provide a static bell, which carries the metal sheath gradually away from the insulation material of the cable, thereby removing all abnormal static stresses which otherwise would be set up between the conductor and the lead sheath. The inner surface of the bell is parabolic in shape, and the metal construction is extended to a point where it is impossible, it is declared, for a static discharge to be established. Since the inner surface of the bell is smooth and is concentric to the cable, a uniform shield of static distribution is produced, it is asserted, and a gradation of all electric static stresses is effected.

The parabolic static shield is completely incased in an insulating compound whose dielectric strength is comparable to that of the insulating material of the cable. As a result the stresses in the rubber or other insulated cable covering are kept well within safe operating limits. The manufacturer points out that the construction allows the compound to fill all the space between the cable insulation and the lead sheath and prevents the interposition of a film of air at the point where the cable leaves the sheath, which would be liable to cause a cable and pot-head failure. Another feature of the Franklin cable pot-head is the protection given by the base to the cable from subsequent strain due to carelessness in cutting away the lead sheath of the cable at the time the pot-head is installed. The parabolic bell forces away the lead sheath from the cable at the line of cutting, leaving a space which fills completely with compound. In the design of the base provision has been made for clamping the lead sheath between two rotating members so constructed as to produce a water-tight joint, thereby eliminating the necessity of a plumber's wiped connection. The principle of clamping the lead by screwing one clamping surface into the other insures a uniform pressure on the cable sheath, it is claimed, and owing to the accurate construction of the two surfaces also insures the water-tight union already noted.

The body of the cable pot-head is of fiber, porcelain or metal, depending entirely upon the class of service required. The fiber envelope has proved effective in station practice where a cylindrical type of construction is de-

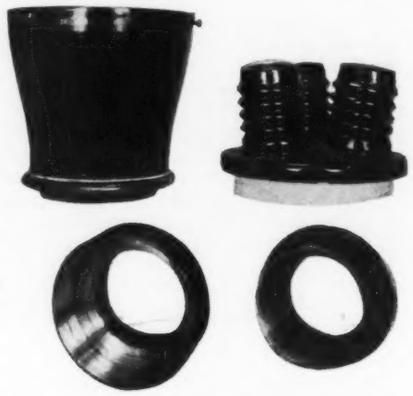


FIG. 2—DISASSEMBLED PARTS OF THREE-CONDUCTOR POT-HEAD

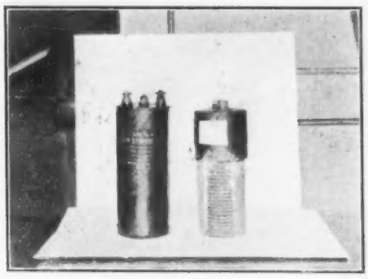
sired. It offers various points of advantage, such as minimum size, ruggedness and ease of installation. Special bodies other than of cylindrical shape are manufactured of metal or porcelain.

The covers of all types of Franklin cable pot-heads are non-metallic, even a lava bushing and cap being provided for pouring in the compound. With the non-metallic covering there is less liability of failure, it is claimed, and lightness of construction is obtained.

FIGS. 3, 4, 5, 6 AND 7—OUTSIDE AND SECTIONAL VIEWS OF SINGLE-CONDUCTOR AND THREE-CONDUCTOR CABLE POT-HEADS

A "Dry" Storage Battery

A lead storage battery which in size and shape resembles an ordinary salammoniac dry cell and contains a non-flowing electrolyte is being manufactured by J. P. Mentzer & Company under the Crowdus patents and is



LEAD STORAGE BATTERY OF SAME SIZE AS STANDARD DRY CELL

being sold by S. S. Stolp, 134 South LaSalle Street, Chicago. According to the manufacturers, tests show that the battery can be recharged an indefinite number of times at a lower price per charge than the original cost of an ordinary dry cell. The rating of the battery is 0.5 amp. for forty hours, 1 amp. for eighteen hours, 2 amp. for eight hours, or 3 amp. for five hours. The average discharge potential is 2 volts.

The container for the battery is an unbreakable paper-fiber can, made proof against water, acid and electrolysis. The positive and negative elements are made from rolled strips of corrugated lead. The electrolyte is contained in an amorphous, non-crystallizing white substance which is said to possess exceptionally high absorbing power. A tube provided in the center of the cell carries water to prevent the cell from drying out.

Combination Motor-Driven Blower for Mechanical Orchestras

An electric outfit for operating the mechanical orchestras frequently employed in motion-picture theaters and other amusement places, which consists of a pressure fan and several suction fans directly connected to one motor as shown in the diagram in Fig. 2, has been developed by the Kinetic Engineering Company, Baltimore Avenue and Sixtieth Street, Philadelphia, Pa. The pressure principle is utilized for operating the organ element of the mechanical orchestra, while the suction system is utilized to operate the piano element and various mechanical instruments, such as drums, bells, etc. The fans are inclosed in a soundproof box which is provided with a pressure outlet and a suction inlet. Each fan is separated from the others by means of a casing as shown in the diagram, the air following the path indicated by the arrows. The combination-blower outfit is advantageous because of the fact that it takes the place of a separate pressure system and suction system, thereby saving considerable space.

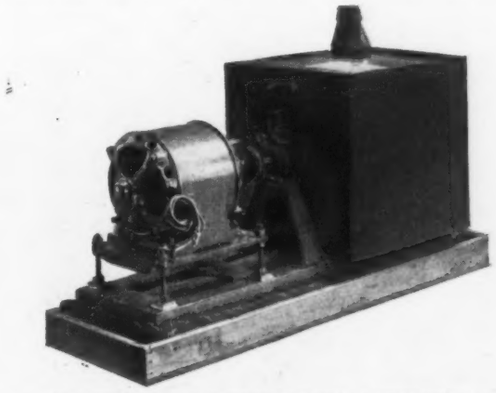


FIG. 1—MOTOR-DRIVEN COMBINATION PRESSURE AND SUCTION BLOWER FOR OPERATING MECHANICAL ORCHESTRA

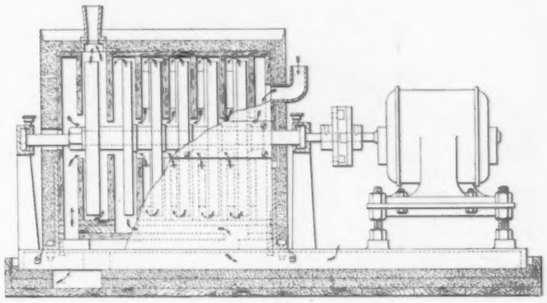
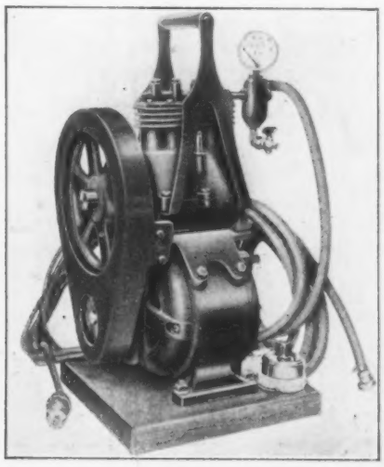


FIG. 2—SECTIONAL DIAGRAM OF COMBINATION BLOWER

Electric Tire Pump

Among the many new electrically operated devices that are being developed from time to time for use in the garage, the tire pump shown in the accompanying illustration is worthy of mention on account of several interesting features. The entire outfit is self-contained and consists of a motor-driven pump, a pressure gage, an air hose, an acorn connection and a snap switch for starting and stopping the motor. A handle is provided so that it can be easily carried, or it may be mounted on a small carriage if desired. The air pump, which is mounted on the motor, is equipped with four cylinders, insuring, it is claimed, a steady flow of air. The corrugations on the cylinders assist in dissipating the heat generated by the compression of the air and keep the operating temperature low. Metal pistons, each fitted with two compression rings, are used. The connecting rods and main bearings are of bronze. The machine is driven by an 0.25-hp. Westinghouse type CA or type CD motor, this depending upon whether alternating current or direct current is utilized. All electrical contacts are shielded and the working parts are inclosed. Lubrication is accomplished by means of the splash system. The pump is called the "Guco," and is being made by the General Utility Company, 1330 Ogden Street, Philadelphia, Pa.



TIRE PUMP DRIVEN BY 0.25-HP. MOTOR

Device for Regulating Lighting of Ford Cars

A device consisting of an impedance coil designed for regulating the lighting of 1915-model and 1916-model Ford automobiles has been developed by the St. Louis Electrical Works, Arlington and Easton Avenues, St.

IMPEDANCE COIL FOR REGULATING LIGHTING SYSTEMS ON FORD CARS

Louis, Mo. The "Evenlite," as it is called, may be attached to the dashboard under the hood beside the lighting switch by means of two screws.

Two-Cell, Three-Volt Dry Battery

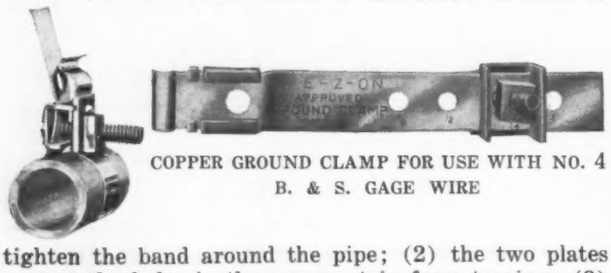
As a substitute for the ordinary 6-in., 1.5-volt dry battery employed in various types of hand lamps now on the market, the Interstate Electric Novelty Company, 29 Park Place, New York, has brought out the two-cell, three-volt battery shown herewith. This battery is

THREE-VOLT DRY BATTERY

made up of two separate cells, the combined outfit being of the same size and shape as a standard dry battery. The double cell is especially adapted for use in hand lamps and bicycle lamps.

Ground Clamp

A single-piece clamp of copper equipped with a copper-plated bolt and nut for clamping to rigid conduit has been developed by M. I. Ginsburg, 109 North Sixth Street, Philadelphia, Pa. The device is designed for use with No. 4 B. & S. gage wire and is adjustable for conduit up to and including the 1-in. sizes. One end of the clamp is channeled to form the equivalent of a lug for soldering to the ground wire. Advantages of the device as set forth by the manufacturer are as follows: (1) The whole force of the screw is used to



COPPER GROUND CLAMP FOR USE WITH NO. 4 B. & S. GAGE WIRE

tighten the band around the pipe; (2) the two plates protect the holes in the copper strip from tearing; (3) the screw is close to the pipe and the back plate is raised to prevent the nut from turning while the screw is being tightened, and (4) the clamp can be quickly installed.

Table, Desk and Bed Lamps

A number of different types of handy portable lighting fixtures designed for a variety of purposes in the home and office have been placed on the market by the Faries Manufacturing Company, Decatur, Ill.

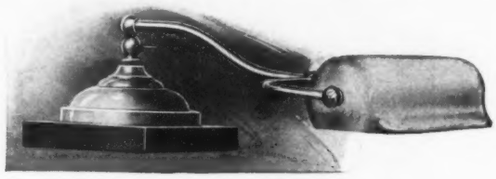


FIG. 1—PIANO OR ROLL-TOP-DESK LAMP WITH ARM WHICH SWINGS HORIZONTALLY

Included in its "Verdelite" lighting devices are the roll-top desk or piano lamps shown in Figs. 1 and 2 and the flat-top desk or table lamp shown in Fig. 4. The fixtures are provided with cast-iron bases and a heavy sheet of felt on the bottom of the bases, so that

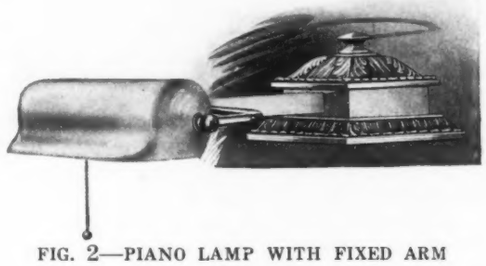


FIG. 2—PIANO LAMP WITH FIXED ARM

they will not scratch or mar the surfaces on which they are placed. The shades are of green glass outside and have white-opal glass reflecting surfaces inside. The shades for the fixtures shown and for other devices included in the "Verdelite" line are of the same size and

FIGS. 3 AND 4—ORNAMENTAL FLOOR AND TABLE LAMPS

shape, are interchangeable, and can be employed with 25-watt to 60-watt tungsten lamps.

The piano lamps shown in Figs. 1 and 2 extend 12 in. from the center of the base to the center of the shade. The table lamp shown in Fig. 3 is one of several

types of single-lamp and two-lamp fixtures developed by the Faries company. It is 16.5 in. high and the base is 6 in. by 6 in. The floor lamp illustrated in Fig. 3 is adjustable in height from 2.5 ft. to 5 ft. and is provided with hinged joints. The base of the device is 9 in. in diameter. The fixture is finished in brushed brass

FIGS. 5 AND 6—PORTABLE FIXTURE WITH CLAMP AND CANDLE STEM

and is one of several types of adjustable floor lighting fixtures made by the above-named concern.

Another interesting device brought out by the Faries Manufacturing Company is the "Handi-Lamp Portable" device illustrated in Fig. 5. It is 14 in. high and has a spread of 11 in. over all. It is equipped with a clamp which fits any thickness up to 1.75 in. The lamp is adapted for a variety of uses. Another line of fixtures

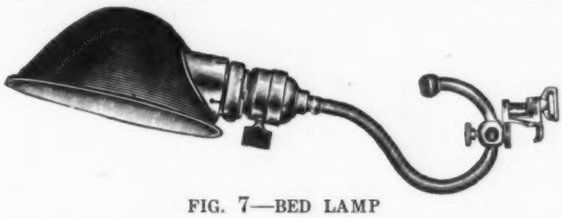


FIG. 7—BED LAMP

worthy of note made by the Faries company is its adjustable-bracket fixtures for brass and wooden beds, one of which is shown in Fig. 7. The fixture shown is designed to fit any wooden-bed rail or post varying from ⅜ in. to 1 in. square.

An adjustable candle stem is shown in Fig. 7 which is designed for use on any size or length of candle for either fixture or bracket. It is made of heavy tubing which is opened to facilitate wiring. The candle stem is being made in two sizes, 2.25 in. to 3.25 in. and 2.75 in. to 4.5 in.

Automatic Electric Cooker and Water Heater

Certain improvements have been made in the electric cooker which was described in the ELECTRICAL WORLD of Nov. 14, 1914. The cooker is provided with double walls between which is a small quantity of water that is turned into steam when energy is supplied to the heater. Radiation from the outer wall of the cylinder is prevented by a layer of non-conducting material. Inside the cylinder are compartments for cooking receptacles. After the current is turned on, the temperature of the oven is automatically maintained uniform by a steam-pressure diaphragm, which interrupts or closes the circuit as the pressure varies. Electricity is used intermittently, the manufacturer points out, about one-fourth to one-fifth of the time the cooker is working. The improved type of cooker, which is designated as the model C device, is provided with hot-plates which may be used for frying, boiling small quantities of water and the like. It is also provided with a portable oven, which may be employed for certain kinds of cooking requiring only a short time and constant watching, as in baking biscuits, pies and layer cakes. The outfit which is illustrated herewith is being placed on the market by the Good Housekeeping Cooker Company, Berkeley, Cal.

The company has also developed a 750-watt electric water heater which may be installed in a 10-gal. tank

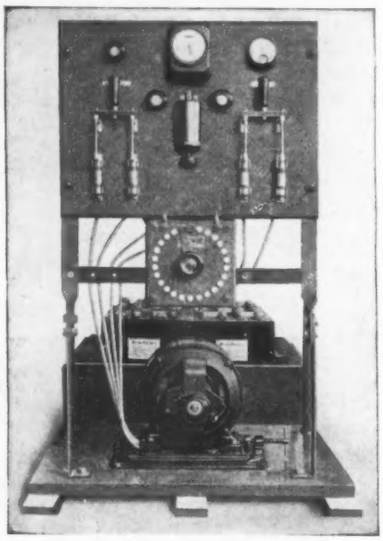
AUTOMATIC ELECTRIC-STEAM OVEN WITH DISK STOVES AND SMALL AUXILIARY OVEN

for supplying hot water to an ordinary family of three or four people. For larger families 18-gal. or 20-gal. tanks are utilized and heaters with ratings of 1000 watts, 1500 watts or 2000 watts are used. When a temperature of about 180 deg. is attained, the energy supply is automatically cut off, and it will remain cut off until hot water is turned from the tank and cold water takes its place. With this electrically heated water system hot water can be provided at the faucet at any time, the manufacturer claims, during the twenty-four hours.

Small Generating Outfit

A generating set which is well adapted for use in country homes, on farms and in small manufacturing establishments in rural districts is shown herewith. The plant consists of a Westinghouse low-voltage generator and control panel and a "Hyray Exide" storage battery, all of which are mounted on skids, rendering the outfit portable. The generator may be operated by any ordinary oil, gas or gasoline engine, or, if available, water-

power can be employed. Use is made of an automatic device on the control panel for maintaining a steady voltage on the battery when charging. An ampere-hour meter is also utilized to show at all times the exact amount of reserve energy in the storage battery and to indicate when to start and stop the charge. The outfit



SMALL LIGHTING OUTFIT

complete is being placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Electrically Illuminated Changeable-Letter Program Board

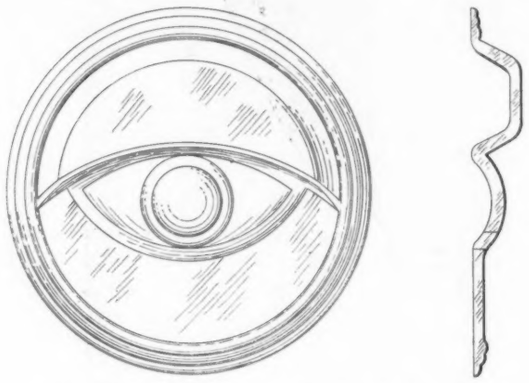
The "Nu-Flex" program board, as it is called, is of the changeable-letter design and is adapted especially for use by motion-picture theaters and vaudeville houses. The board measures 68 in. high, 32 in. wide and 6 in. deep, being finished in dead-black enamel, which is baked on. The inside is finished in aluminum. Use is made of ten slides, each of which measures 6 in. by 30 in. and is of white opal glass, metal-bound, to protect against breakage. The reflector is equipped with five double sockets, 10-watt lamps being generally used. The letters are of the "cut-out" type, of dead-black color,

ELECTRICALLY ILLUMINATED PROGRAM BOARD

and are 3 in. high. By means of a tongue-and-groove arrangement the letters are suspended on a fine, rustproof wire. The program board may also be provided with separate compartments and wired so that each slide may be illuminated independently. The device is being made by the Nu-Flex Manufacturing Company, 160 North Fifth Avenue, Chicago, Ill.

Automobile Headlamp Lens That Reduces Glare

The automobile headlamp lens illustrated is designed to give safe light for driving and yet to minimize glare. A bull's-eye throws a shaft of light ahead of the car along the roadway, while the crescent-shaped part of the lens is constructed so as to project rays laterally well beyond the road limits on either side, providing

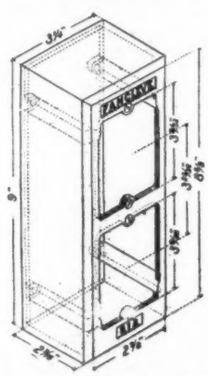


HEADLAMP WITH LENS FOR REDUCING GLARE

light necessary for making turns in the road. The lens, it is said, will meet the most exacting city traffic conditions and at the same time deliver ample light for touring. Palmer & Bachelder, illuminating engineers, 714 Hartford Building, Chicago, are distributing sales agents for this new product.

Tandem Boxes for Exposed Work

Two-gang, three-gang and four-gang tandem boxes of recently developed types for exposed work are being made by the Fancleve Specialty Company, Jamaica Plain, Mass. The backs of the boxes are separable in order to facilitate cutting the side or top and bottom walls for the introduction of wood or metal molding. No holes or "knock-outs" are provided for conduit or cable ports, but holes are drilled or tapped. Each cross-yoke supports two lugs for switches or receptacles, providing the maximum space, it is declared, for making connections and fastening conduit bushings. The face is designed to seat comfortably all standard tandem



BOX WITH SEPARABLE BACK

flush plates. The dimensions given in the illustration indicate the maximum size of lock-nut or bushings that may be revolved on the walls. The boxes are finished by galvanizing by the hot process. Boxes for horizontal work of the type mentioned above (single-gang to six-gang) are also being manufactured by the Fancleve company.

News of the Industry

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Activities of the Associated Manufacturers of Electrical Supplies

Three new sections were added to the Associated Manufacturers of Electrical Supplies during the month of December, indicating the growing strength of the organization, not yet a year old.

In response to a call issued by the general secretary to the manufacturers of inclosed fuses and accessories, a meeting was held on Dec. 2, at the Hotel Biltmore, New York, to consider the formation of a section in the association to cover that branch of the industry. The meeting was well attended, and the vote was unanimous for the formation of a section to be known as the "fuse section." H. R. Sargent of the General Electric Company was appointed permanent chairman of the section, R. C. Buell of the Johns-Pratt Company, Hartford, secretary, and F. V. Burton of the Bryant Electric Company, Bridgeport, Conn., treasurer. Three standing committees were appointed, on cartridge fuses, plug and open fuses, and cut-outs and accessories.

Membership in the section is confined to members of the Associated Manufacturers of Electrical Supplies engaged in the manufacture of fuses for electric light and power circuits and in making accessories for such fuses.

At the meeting held on Dec. 8 at the Hotel Biltmore, New York, when the molded or formed insulations section of the Associated Manufacturers of Electrical Supplies was formed, the following officers were elected: E. B. Hatch of the Johns-Pratt Company, Hartford, Conn., permanent chairman; R. W. Seabury of the Boonton (N. J.) Rubber Manufacturing Company, secretary, and Joseph Steinberger of the General Insulate Company, Brooklyn, N. Y., treasurer. After consideration rules were adopted covering the section, and the following sub-committees were appointed: Molded-rubber insulation, fiber insulation, suspension and third-rail insulation, high-head molded insulation, molded-composition insulation, and miscellaneous insulation.

The interests of the manufacturers of the various kinds of insulating materials will be classified under the above sub-committees, each sub-committee choosing its own chairman, who with the chairman of the section and the treasurer will constitute the executive committee of the section.

On Dec. 14 a meeting of the manufacturers of switchboards and panelboards was held for the purpose of organizing a section in the Associated Manufacturers of Electrical Supplies to be known as the panelboard and switchboard section. Fred B. Adam of the Frank Adam Electric Company, St. Louis, was the temporary chairman of the meeting. D. K. Chadbourne of the George Cutter Company, South Bend, Ind., was elected permanent secretary of the section, and William T. Pringle of the Pringle Electric Manufacturing Company, Philadelphia, was elected permanent treasurer. Nominations for permanent chairman of the section will be presented to the board of governors at its next meeting. Four standing sub-committees were appointed, on panelboards, switchboards, knife switches, and cabinets.

Membership in this section is confined to members of the association engaged in the manufacture of panelboards and switchboards.

Electric-Vehicle Manufacturer to Build Gasoline-Electric Car with Magnetic Clutch

A consolidation of the Owen Magnetic Company, New York City, manufacturer of the Owen magnetic car, and the Baker, Rauch & Lang Company, Cleveland, Ohio, has been effected. The new concern will be known as the Baker, Rauch & Lang Company, but the cars to be manufactured will be known as the "Owen magnetic," which will be built in two models. The Baker factory in Cleveland will be given over to the manufacture of Owen magnetic cars. The Rauch & Lang factory at Cleveland will be used for the manufacture of bodies for the Owen magnetic and in addition will continue the manufacture of electric cars, which the Baker, Rauch & Lang Company has been producing. The capital of the Baker, Rauch & Lang Company will be increased from $2,000,000 to $5,000,000.

The General Electric Company, which recently obtained a considerable interest in the Owen magnetic or Entz patents, will have directors on the board because of its interests in the electric transmission used in the magnetic cars. Anson W. Burchard, vice-president of the General Electric Company, D. C. Durland and Richard H. Swartwout have been elected to the board of directors of the new company, representing the General Electric interests. The present Owen factory in New York City will be continued for development purposes as well as being employed as a service department. The assets of the Owen Magnetic Company, however, have all been acquired by the Baker, Rauch & Lang organization.

It has been known for some months that the Baker, Rauch & Lang Company was producing a gasoline-electric car built under the Entz patents, which are the basic ones in the Owen magnetic design. This car is a smaller one than the present Owen magnetic, which has been on the market during the past year. The Fort Wayne Works of the General Electric Company are already supplied with the necessary tools to take care of the manufacture of electric units for these two models of Owen magnetic cars, as well as to manufacture units for other concerns that may be licensed under the Entz patents to manufacture magnetic cars.

Flood-Lighting Being Considered for Springfield (Mass.) Municipal Group

The United Electric Light Company of Springfield, Mass., and William E. Hodge, deputy superintendent of street lighting for the city, have worked out a plan for the flood-lighting of the now famous municipal group of buildings on Court Square, including the campanile tower. It is estimated that the installation can be made for about $450 and that the cost of operation will not exceed $2 per hour, through the use of gas-filled lamps. The plans have been submitted to Mayor Stacy, who is enthusiastic over the scheme, and the city property committee will shortly consider the matter. Mr. Hodge states that if the plan is carried through promptly the group can be illuminated by New Year's Eve. Minor changes in the street-lighting in front of the buildings will be required. In its proposition to the city the

United company offers to install and maintain that part of the system outside the municipal group if the city will install and maintain the equipment directly connected with the group, the city agreeing to use the system 500 hours a year. The company also agrees to impose the regular street-lighting charge for curb lamps, which are a part of the proposed system. Mr. Hodge estimates that the flood-lighting of the group will not cost over $1 per hour more than the present illumination.

Universities May Aid Big Business

The Chamber of Commerce of the United States is inquiring into the possibility of bringing about closer co-operation between the universities and large business interests. W. M. McCormick of Baltimore has suggested that the Chamber of Commerce call a meeting in Washington of the presidents of twelve prominent educational universities and the heads of twelve industrial or manufacturing plants. This meeting would consider the possibility of asking the universities to handle specific problems arising in industries, making experiments if necessary and endeavoring to organize a course of study which would turn out graduates who would find employment in the industries.

Ohio Court Decision Favorable to Municipal Plants

In the case of the Dravo-Doyle Company against the village of Orrville, seeking the recovery of $41,000 for equipment supplied for a municipal electric plant, the Ohio Supreme Court reversed the decision of the Wayne County Court of Appeals and declared Section 3990 of the General Code unconstitutional. This section made it incumbent upon villages to purchase any privately owned gas or electric plant or secure it by condemnation and appropriation proceedings before it could build a municipal plant. It was intended to protect the private capital invested in such plants against the tendency toward confiscation by municipal ownership.

This decision opens the doors to municipal ownership without consideration of privately owned plants or contracts made with them, since Section 3990 contained a clause protecting such contracts also. It further puts the investments in such plants at the mercy of village councils or the majority of voters in the villages.

The decision, which was unanimous, calls attention to the broad powers granted under the municipal home-rule amendment to the constitution to construct and acquire public utilities the product or service of which is to be supplied to the people. The decision, however, does not affect the status of utility corporations in the cities.

It is believed by some that this decision will give great impetus to municipal ownership in the villages, and already contractors are asking for copies of the decision in order that they may be guided in their negotiations with villages which decide to build municipal plants. Indications of late, however, have pointed to a decline of the municipal-ownership idea.

Emergency Lighting Connection for New York Subways

A contract has been entered into with the Interborough Rapid Transit Company of New York by the United Electric Light & Power Company for the supply of break-down emergency service for the lighting of the subway system from South Ferry to the northern part of Manhattan Island on both the Van Cortlandt Park and Bronx Park sections.

In order to fulfill the contract the United company will have to install forty separate service points in an equal number of subway stations, and the connections will be ready for operation about Feb. 1, 1916. The installation totals approximately 270 kw. for lighting, and is under the company's regular break-down rate of $24 per kilowatt per annum plus the general rate for the energy actually consumed.

The circuits will be controlled by specially designed transformers equipped with a no-voltage-release switch, which provides that when the subway system is dead the United service shall be immediately thrown in on the line, lighting the entire subway system, together with the stations which it supplies.

Holding Company Advocates Competition

That competition in public service is preferable to regulation of rates by the Public Service Commission of Missouri was the position taken by the Light & Development Company of St. Louis to obtain for its subsidiary, the Western Power & Light Company, a franchise to compete with the Electric Company of Missouri in Maplewood, a suburb of St. Louis.

On Dec. 7 an election was held at which the competing franchise was granted by a vote of 624 to 288. In the campaign for this election the voters were told, through advertising, circulars, and by solicitors, that competition in electric service would secure the lowest rates. It will be interesting to note what action the Public Service Commission of Missouri will take when the Western Power & Light Company applies for a certificate of convenience and necessity to exercise its franchise.

Municipal Lighting Rate Declared Too Low

In a recent report on the Chicopee (Mass.) municipal electric plant, C. W. Whiting, consulting engineer, Boston, pointed out that the lighting rate of 4 cents per kilowatt-hour maintained by the plant is too low, criticised the bookkeeping methods of the department, and emphasized the need of better management. According to an abstract of the report published in the Springfield *Republican*, Mr. Whiting said further that the distribution system needs a thorough overhauling, with better systematization of circuits; that the meters should be tested, and that future street lamps installed should be of the incandescent type. The report also stated that the plant needs a fireproof garage and incombustible roof for the coal shed, which has been on fire twice within the last few months. Mr. Whiting said that with proper management the plant should be made a success.

Milwaukee Municipal Street-Lighting System Probable

Despite the protests from the local taxpayers' league, the Milwaukee (Wis.) Board of Estimate included $750,000 worth of municipal street-lighting bonds in the budget that will be presented to the City Council some time between Christmas and Jan. 1. The funds derived from the sale of the bonds, if the budget is approved, will be used to construct a street-lighting system conforming to the specifications submitted after an exhaustive survey made by Vaughn, Meyer & Sweet. Whether the city builds its own lighting system or not, it is expected that the energy required for operating it will be purchased from the Milwaukee Electric Railway & Light Company.

NOTES
ON ELECTRICAL TOPICS

Model Street-Lighting Contract for Ohio.—The illumination committee of the Ohio Electric Light Association is collecting street-lighting contracts from the various cities in Ohio for the purpose of being guided in preparing a model street-lighting contract for the State.

Emergency Calls in Brooklyn.—During the first seven months of 1915 the emergency bureau of the Brooklyn (N. Y.) Edison company handled 24,370 low-tension calls. This number may be compared with 30,587 similar calls handled during the year 1913 and 38,717 in 1914.

Lack of Imported Carbon Causes Arc-Lamp Trouble.—The lack of high grade imported carbon, it is stated, is causing considerable trouble in the Penn Central Light & Power Company in maintaining service of flaming-arc lamps. Since the supply of German and Austrian carbon fell off some months ago the lamps have not been giving efficient service, and no remedy has been found for the trouble. The Altoona shops of the Pennsylvania Railroad have abandoned all their flaming-arc lamps and will not use them, it is stated, until new supplies of carbon can be secured from Germany and Austria.

Newly Discovered Spanish Platinum Deposits in Hands of Government.—Professor Orueta, who recently discovered in the Ronda Mountain Range in Spain very rich deposits of platinum, chromium and nickel, has relinquished his claims to the Spanish government. By royal decree, published in the *Gaceta de Madrid*, the official organ of the Spanish government, the territorial limits of the mines are defined. Concessions to exploit the mines are obtainable from the Spanish government and will be granted to foreigners as well as to Spanish subjects. The deposits of platinum are said to be the richest in the world.

Hearing on Appeal of Cleveland Light Rate Postponed.—By agreement of all parties, the Ohio Public Utilities Commission postponed the hearing of the appeal of the Cleveland Electric Illuminating Company from the light-rate ordinance passed by the Cleveland City Council from Dec. 16 to Jan. 13. The ordinance provides for a flat 3-cent rate. The company has submitted but little of its inventory as yet. A resolution was recently adopted by the City Council asking Director-of-Law Stockwell for a report on the status of the city's contention with the company on this subject. The action of the commission will enable him to make a very clear report.

Georgia-South Carolina State Line Tax Contest to Go to Supreme Court.—Following the action of the Superior Court in denying an injunction sought by the Georgia Railway & Power Company to prevent the State of Georgia and the county of Elbert from collecting certain taxes on the Gregg Shoals power plant of the power company, which is situated on the Savannah River in Elbert County, attorneys for the power company have announced that an appeal will be made to the United States Supreme Court asking a continuance of a temporary injunction against the collection of the disputed taxes. The power company fought the tax on the contention that Georgia was seeking to tax a part of the power plant in South Carolina on which South Carolina also was levying taxes.

School for Submarine Electricians Opened.—An experimental school of electricity for officers and men of the United States submarine flotilla has been opened at Orange, N. J., by Thomas A. Edison, chairman of the Naval Advisory Board, acting in co-operation with Secretary Daniels. Men are being sent to the school each week from the different stations along the Atlantic Coast. The first four groups to take the course totaled forty-one officers and eighty-six men. Besides attending lectures on the electrical equipment of submarines, the men made a detailed study of the manufacture of batteries at the Edison works. At the end of the week's course a three hours' examination is held in order to clear up any points on which the men might be hazy. The course is in charge of Dr. M. R. Hutchison.

Electrical Laundry for Dirty Bills.—Thousands of dollars of greenbacks and yellowbacks of all denominations are now being washed daily by the United States Treasury Department in specially built electrical washing, drying and ironing machines. By constant use bills become dirty and grimy in a short time. To destroy such bills and issue new ones when they were not otherwise damaged was found to be very expensive and highly inefficient. Machines were therefore installed into which dirty and crumpled bills are introduced at one end to come out of the other end in a couple of minutes looking like new. One of these machines was exhibited at the recent New York Electrical Show. It is motor-driven and capable of washing, rinsing and pressing 6000 bills an hour. Banks from all parts of the city sent dirty money to be electrically laundered.

AN ELECTRIC LAUNDRY FOR DIRTY AND CRUMPLED GREENBACKS

Radio Amateurs May Aid Government.—Secretary of the Navy Daniels in a letter to the recently formed National Amateur Wireless Association expressed his sympathy with the movement and said that he felt that such an organization could play a considerable part in the large scheme of national defense. He further requested a list of members' names and addresses so that in time of need the Naval Radio Service would have at hand a list of willing and capable radio operators on whom to call for volunteer service. The association has now a membership of close to 1000 and has become affiliated with several smaller organizations.

British Institution Receives Faraday Relics.—A number of books, papers, notes, photographs, etc., which formed the major part of a collection of relics of Michael Faraday, and which had been bequeathed by will to David J. Blaikely by his sister-in-law, Miss Jane Barnard, a niece of Faraday, have been presented by Mr. Blaikley to the British Institution of Electrical Engineers. One interesting part of the collection is a framed series of lines-of-force diagrams made on gummed paper by Faraday himself. W. M. Mordey added to the collection two articles, one of which was a book containing notes in Faraday's handwriting on various topics which attracted his attention when a boy.

Ohio Board Refuses to Repair Aqueduct Used by Cincinnati Central Station.—Although the State Board of Emergency Appropriations has refused to appropriate $7,500 to repair the canal aqueduct at Carthage so that the plants of the Union Gas & Electric Company at Cincinnati shall be insured a proper supply of water through the winter, President W. W. Freeman said the company will do what the State should do under its contract and that its customers will be protected against any shut-downs from that cause such as had been prophesied by the State Board of Public Works. The company is paying rent for the water supply, Mr. Freeman said, and the State is obligated to keep the aqueduct in repair so that there will be a constant supply.

Engineering Research Fellowships Available at University of Illinois.—There are now available to graduates of approved universities and technical schools fourteen research fellowships in the engineering experiment station of the University of Illinois. Nominations to fellowships, accompanied by assignments to special departments of the engineering experiment station, are made from applications received by the director of the station each year not later than Feb. 1. Nominations are made within the month of February and appointments in March to take effect the first day of the following September. Research work may be undertaken in architecture, architectural engineering, chemistry, civil engineering, electrical engineering, mechanical engineering, mining engineering, municipal and sanitary engineering, physics, railway engineering, and in theoretical and applied mechanics.

Dallas Electric Club.—On Dec. 10 H. C. Bramley spoke before the Dallas (Tex.) Electric Club on "How to Fit the Man to the Job."

Pittsfield Section, N. A. S. E.—A lecture on "Lubrication" was given before the Pittsfield Section of the National Association of Stationary Engineers on Dec. 2.

Pittsburgh Section, A. I. E. E.—J. J. Carty, president of the American Institute of Electrical Engineers, addressed the Pittsburgh Section of the association on Dec. 4.

Pittsfield Section, A. I. E. E.—The Pittsfield (Mass.) Section of the American Institute of Electrical Engineers held a dinner and dance at the Wendell Hotel on the evening of Dec. 9.

Wood Preservers' Convention to Be Held in Chicago.—At the twelfth annual convention of the American Wood Preservers' Association, which is to be held at the Hotel Sherman in Chicago on Jan. 18, 19 and 20, the effect of the European war on the American timber-treating industry will be discussed.

Utah Electric Club.—An unusually large number of members of the Utah Electric Club gathered at the regular luncheon on Dec. 2 at the Commercial Club to hear R. E. Richardson of the Electric Bond & Share Company, who spoke on the "Status and Importance of the Electric Workers in the Country."

Ohio Electric Light Association Committee Meeting.—The calendar for standing committee meetings of the Ohio Electric Light Association is as follows: New-business co-operations committee, Akron, Jan. 19, 1916, Springfield, March 15, 1916, and Newark, May 17, 1916; transmission and distribution committee, Akron, Jan. 18, 1916; meter committee, Akron, Jan. 20, 1916.

Luckiesh Speaks on "School Lighting."—Before the December meeting of the Chicago Section of the Illuminating Engineering Society M. Luckiesh of Cleveland presented a paper on "School Lighting," in which he laid down a tentative code for the daylight and artificial illumination of all school buildings. Discussion of the paper consisted largely of suggestions for minor changes in the code.

Coming Conventions of A. I. E. E.—At the meeting of the board of directors of the American Institute of Electrical Engineers held Dec. 10, 1915, it was decided to hold the usual midwinter convention in New York City on Feb. 8-9, 1916. At the same meeting a Pacific Coast convention, to be held in Seattle, Wash., in 1916, under the auspices of the Seattle Section of the Institute, was authorized, the date to be fixed later.

Joint Meeting of Portland Sections, A. I. E. E. and N. E. L. A.—The regular joint meeting for December of the Portland Sections of the American Institute of Electrical Engineers and the National Electric Light Association was held on Dec. 7 in the assembly room of the Electric Building. A paper was read by O. C. Brill of the Pacific Telephone & Telegraph Company on "The Construction of the Transcontinental Telephone Line."

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Chicago Electric Club - Jovian League.—H. N. Foster, traffic superintendent Chicago Telephone Company, made the address at the Dec. 23 meeting of the Chicago Club-Jovian League. His topic was "The Modern Seven-League Boots." A. A. Gray, general manager of the *Electrical Review and Western Electrician* will speak at the meeting on Dec. 30 on "A Review of the Development of the Industry During 1915."

Indianapolis Jovians Rejuvenate.—At the Electrical Prosperity Week rejuvenation and joviation of the Indianapolis Jovian League fifty new members were taken into the order. The speakers at the banquet included Judge Louis Ewbank of the Marion Circuit Court, president of the local league; Charles W. Miller, formerly district attorney; Mayor Joseph E. Bell, Thomas A. Wynne and E. C. Bennett, reigning Mercury, of St. Louis.

Lynn Section, A. I. E. E.—The Lynn Section of the American Institute of Electrical Engineers held a well-attended meeting on Dec. 15. An address on "The Effect of Legislation on Our Industries" was delivered by A. G. Duncan, president of the National Association of Cotton Manufacturers. At a special meeting of the section on Dec. 8 F. P. Cox of the Lynn Works of the General Electric Company delivered an address on "Recent Developments in Meters and Instruments."

Convention of National Society for the Promotion of Industrial Education.—The ninth annual convention of the National Society for the Promotion of Industrial Education will be held at the Hotel Radisson, Minneapolis, Minn., on Jan. 20, 21 and 22, 1916. Preliminary to the convention there will be held on Jan. 19 and 20, on invitation of the Minneapolis Civic and Commerce Association, an informal conference of employment managers. The secretary of the society is Alvin E. Dodd, with offices at 140 West Forty-second Street, New York City.

New York Section, E. V. A.—The December meeting of the New York Section of the Electric Vehicle Association of America will be held in the Consolidated Gas Company building on Dec. 28. E. W. Curtis, Jr., manager of the London office of the General Vehicle Company, will talk on "Electric Vehicles in Europe." S. C. Harris of the New York Edison Company will present a paper on "Methods of Design and Operation Which Assure Efficiency of the Electric Vehicle." The cups offered by Arthur Williams to the winners in the "Ward special" sales campaign will be presented at this meeting.

National Independent Telephone Societies Unite.—Meeting at the Hotel LaSalle, in Chicago, on Dec. 8, 9 and 10, members of the two rival associations of independent telephone men—the National Independent Telephone Association and the Independent Telephone Association of America—united forces. The new association formed, in which are enrolled members of both former organizations, is called the United States Independent Telephone Association. In the convention of the new body which followed the union the spirit of harmony was prevalent. Attendance records of all previous independent telephone conventions were broken. At some of the technical and accounting sessions 500 men pere present. The officers of the new association are: President, C. Y. McVey, Cleveland; first vice-president, W. H. Bryant, Mobile, Ala.; second vice-president, G. W. Robinson, St. Paul, Minn.; third vice-president, F. B. MacKinnon, Washington, D. C.; secretary-treasurer, W. S. Vivian, Chicago; chairman of the board of directors, E. B. Fisher, Grand Rapids, Mich. In addition to the officers the following men are members of the executive committee: S. G. McMeen, Columbus, Ohio; G. R. Fuller, Rochester, N. Y.; H. L. Reber, St. Louis, Mo.; A. F. Adams, Kansas City, Mo.; W. J. Uhl, Logansport, Ind., and T. W. Allen, Jackson, Mich. Former President William H. Taft addressed the delegates at the banquet on Dec. 9.

Western Electrical Inspectors to Meet in January.—The following tentative program has been arranged for the eleventh annual meeting of the Western Association of Electrical Inspectors, which will meet at the Hotel Sherman, Chicago, on Jan. 25, 26 and 27, 1916: "The Legal and Ethical Responsibility of the Electrical Inspector," by Leon Hornstein, assistant corporation counsel for the city of Chicago; "The Electrical Safety Code," by Dr. E. B. Rosa, chief physicist of the Bureau of Standards, Washington, D. C.; "Fuses, the Electrical Safety Valves," by Prof. H. E. Clifford, Harvard University; discussion of inspectors' problems, covering such topics as inclosing of live parts, gas-filled lamps, fixtures and wiring, safeguarding electrical hazards in garage wiring, organ wiring, new code rules, use of a distinctive marker for neutral wires and automatic substations; "The Central Station's View," by R. S. Hale, Boston Edison company; "The Electrical Contractor's View," "The Electrical Manufacturer's View" and "Grounded Fixtures," speakers not yet selected; "Labeled Motion-Picture Films," by James E. Latta, Underwriters' Laboratories, Chicago. The inspection trips which have been planned will take the delegates to see the Underwriters' Laboratories, the Union Stock Yards, the Essanay Film Manufacturing Company, several downtown buildings with electrically driven fire pumps, high-voltage apparatus at the Commonwealth Edison Company's plants, and wiring details in modern office buildings. William S. Boyd, 175 West Jackson Boulevard, Chicago, is secretary of the association.

Public Service Commission News

District of Columbia

The Public Utilities Commission of the District of Columbia has adopted a form according to which all electric utilities operating in the District of Columbia are to make and file with the commission monthly statements of the number of customers billed, the number of kilowatt-hours billed, and the total revenue billed under each schedule of rates, and a statement for the customers paying a minimum charge. After Jan. 1, 1916, the companies are ordered to keep such records as are necessary in order to compile the required information for each fiscal month.

Maryland Commission

The Public Service Commission has invited electric corporations doing business in Maryland to attend a conference in the offices of the commission in Baltimore on Jan. 12, the conference to last two days if necessary. It is proposed to discuss at this meeting all matters appertaining to electric service with special reference to the following: Inspection and maintenance, interruptions to service, service-testing facilities, records of tests of service, information to consumers, accidents, complaints, voltage variation, meter testing and accuracy, meter-testing facilities, records of meter tests, meter readings and bill forms, meter rentals and deposits, permissible meter accuracy, conditions of test, average accuracy, "normal" load tests, tests on request of consumers, fees for testing on complaint, periodic and installation (service) tests. The chief engineer of the commission has been directed to secure and report to the commission such information as may be necessary to enable the latter to determine the proper standards for electric service. He is authorized to employ such experts as may be reasonably required to advise in the premises, including officers and employees of the Bureau of Standards maintained by the government of the United States.

Massachusetts Commission

The Public Service Commission has issued an opinion to the effect that the board has full jurisdiction in the pending fare case of the Bay State Street Railway Company. The Municipal Officers' Association of Massachusetts contended that the interstate service of the company nullified the regulative powers of the commission, but the board points out that such service is an inconsequential part of the company's business and holds that the proposed increase in fares over the entire system in Massachusetts is an intrastate matter. Objection was also raised upon the admission of the investment valuation of the Bay State system prepared by Sloan, Huddle, Feustel & Freeman of Madison, Wis., but the commission refused to reject this evidence, holding that to limit the investigation to narrow lines would be prejudicial to the public interest.

Hearings were begun last week by the commission upon the proposed fare increases on the lines of the Massachusetts Northeastern Street Railway. The company's tracks cross the Massachusetts-New Hampshire State line about nine times, and as a measure of economy and expedition the New Hampshire Public Service Commission sat with the Massachusetts board in jurisdiction.

Ohio Commission

Louis M. Day has been appointed a member of the Ohio Public Utilities Commission to succeed Judge Oliver H. Hughes, whose resignation became effective on Dec. 15. Mr. Day is an attorney and represented Ross County in the Ohio Legislature for a number of sessions.

Washington Commission

The Public Service Commission of Washington has made reductions in power rates in force in Everett. Reduction was made after showing that this branch of the Puget Sound International Railway & Power Company was making a net profit of 15.8 per cent. The new rates ordered by the commission are 7.7 cents for the first twenty hours, 5.5 cents for the next twenty hours, and 3.3 cents for all above forty hours, with 10 per cent discount. The company's petition to have its traction losses considered as an offset was denied.

Corporate and Financial

Central Maine Power Company, Augusta, Me.—Negotiations for the acquisition of the Penobscot Bay Electric Company and the Greenville Light & Power Company by the Central Maine Power Company have just been completed at Bath, Me., and the deal will be carried out subject to the approval of the Public Utilities Commission. The Penobscot Company furnishes light and power to the towns of Orland, Bucksport, Verona, Prospect, Stockton, Searsport, Belfast and Northport. Two cables have been laid across the Penobscot from Verona to Prospect. The company is to extend its lines to Winterport, Frankfort and Castine in the near future. The Greenville company has acquired the properties of the Dover & Foxcroft Light & Heat Company, the Sangerville Improvement Company, and the Sebec Power Company, and has built a water system at Greenville. The system of water-works, however, was not included in this deal.

Consolidated Gas & Electric Company, Memphis, Tenn.—It is rumored in Memphis that the Consolidated Gas & Electric Company is about to take over the business of the Merchants' Power Company, the plant of which the city has served notice it will buy under the terms of the franchise. This would give the city a plant with no business, and it is stated that the city would be powerless to prevent the consolidation rumored. The Merchants' Power supplies the central part of the city, while the Consolidated serves the residence district. Last summer the city served notice that it would exercise its option on Jan. 1 to take over the plant, an arbitration committee to fix the price in case agreement could not be reached. Some time ago the companies made a joint proposal to lower the rates, but no action has been taken by the city.

Great Western Power Company of California, San Francisco, Cal.—The company has filed with the California Railroad Commission an application for authority to issue to the Western Power Company 274,986 shares of its common stock, of the par value of $27,498,600, in exchange for a like number of shares of stock of the Great Western Power Company of a similar par value, which is all the stock of the latter company except directors' qualifying shares. The Great Western Power Company of California also asks permission to issue and sell to the Western Power Company all or any part of $5,000,000 face value of its ten-year 6 per cent convertible gold debentures at 91 and accrued interest. The application recites that the company has an authorized capital of $60,000,000, divided into 600,000 shares of the par value of $100 each. Three hundred thousand shares are preferred and 300,000 common stock. The preferred stock is non-assessable and bears interest at 7 per cent. The company sells electricity and steam in Plumas, Butte, Sutter, Yuba, Sacramento, Solano, Napa, Sonoma, Contra Costa and Alameda Counties, in San Francisco and elsewhere. Its plant includes a storage reservoir at Big Meadows, Plumas County, with more than 250,000 acre-feet capacity; a hydroelectric generating plant at Big Bend, Butte County, with an installment of 70,000 hp., and 800 miles of distributing lines. The Great Western Power Company of California was organized on Nov. 23, 1915, to acquire the properties and securities of a part or all of the corporations composing what is known as the Great Western Power system. The corporations in the system are the Western Power Company, the Great Western Power Company, the City Electric Company, the California Electric Generating Company, the United Light & Power Company of New Jersey, the United Light & Power Company of California, the Central Oakland Light & Power Company, the Consumers' Light & Power Company, the Equitable Light & Power Company, the Southside Light & Power Company, and the Consolidated Electric Company. The relations existing between the above companies are as follows: The Western Power Company owns all the capital stock except directors' shares of the Great Western Power Company; the Great Western Power Company owns substantially all of the capital stock of the City Electric Company, all of the common stock except directors' shares of the California Electric Generating Company, and all of the capital stock except directors' shares of the Consolidated Electric Company. The Consolidated Electric Company owns the controlling stock interest in the United Light &

Power Company of New Jersey, the United Light & Power Company of California, the Central Oakland Light & Power Company, the Consumers' Light & Power Company, the Southside Light & Power Company, and the Equitable Light & Power Company. The Consolidated Electric Company likewise owns, subject to the liens of the respective mortgages or trust instruments securing the notes and bonds of said companies, all of the physical assets of the United Light & Power Company of New Jersey, the United Light & Power Company of California, the Central Oakland Light & Power Company, the Consumers' Light & Power Company, the Southside Light & Power Company, and the Equitable Light & Power Company. For the purpose of securing money for the development and extension of its system, the following financial plan has been devised, says the application: A debenture issue, supported by an agreement, for $5,000,000, dated Nov. 1, 1915, payable in ten years at 6 per cent, convertible at par and accrued interest after two years and before five years from date into preferred stock at 95 and accrued dividends, redeemable at 101 and accrued interest at any time, on four weeks' published notice. Of the $5,000,000 debentures referred to, $4,500,000 debentures are to be delivered when required by the Western Power Company during the next year, and $500,000 are to be taken within the same period on the option of the Western Power Company. The Great Western Power Company of California, the applicant, is to buy from the Great Western Power Company $4,998,000 par value of shares of the City Electric Company, for not less than $3,000,000 cash, which money is to be lodged with the trustee of the first mortgage of the Great Western Power Company, to be withdrawn to pay for improvements on and additions to the Great Western Power Company's plant. This is all the stock of the City Electric Company, except twenty shares. A general and refunding mortgage is to be secured by a direct lien on all the property of the City Electric Company, subject to its first mortgage, and on all the properties and franchises of the Great Western Power Company of California, and by the deposit of certain first mortgage bonds of the City Electric Company and the Great Western Power Company which are treasury assets of those companies. The aggregate amount of bonds to be issued under the general and refunding mortgage is to be unlimited, or not more than $150,000,000. These bonds are to run for not less than thirty years, at 6 per cent. The Western Power Company has agreed with Eastern bankers to sell them all the $4,500,000 of debentures to be acquired by the Western Power Company at 96 per cent, except debentures bought by the Western Power Company and Western Power Corporation stockholders at the same figures. These banking firms have also agreed to sell to the Western Power Company $800,000 of the first mortgage bonds of the City Electric Company at 90 per cent.

Iowa Railway & Light Company, Cedar Rapids, Iowa.—Seven per cent preferred stock of the company is being offered at par and accrued dividend. Of the earnings 66 per cent is derived from light and power and 34 per cent from gas, steam heating and electric railways. The earnings statement for the twelve months ended Aug. 31, 1915, follows:

	1915	1914
Gross earnings	$1,325,838	$1,141,924
Operating expenses	791,941	685,628
Net earnings	$533,897	$456,296
Fixed charges	226,405	198,668
Net profits	$307,492	$257,628
Preferred stock dividend	102,470	99,136
Balance	$205,022	$158,492

United Electric Light Company, Springfield, Mass.—An extra dividend of 12½ per cent on the capital stock of the company has been mailed to the stockholders. This dividend was paid in the non-cumulative preferred stock of the Indian Orchard Company and represents the accumulations of undivided profits of that company. Each stockholder in the United Electric Light Company receives one share of the Indian Orchard Company's preferred stock for each eight shares of stock standing in his name at the close of business Dec. 8, 1915. Transferable certificates have been issued for fractions of a share to stockholders whose holdings do not admit of their receiving full shares.

Manufacturing and Industrial

Incandescent Lamp Business Best in History

Domestic trade in incandescent lamps is reported from every direction to be the largest on record. All factories are pushed to capacity output. As was stated at one of the larger factories, the difficulty is no longer one of finding a market, it is one of supplying the market. With additional floor space and more machinery, it is difficult to keep the output up to the pace set by incoming orders. Unlike the demand for motors, which was shown in these columns Dec. 11 to be only for the smaller sizes, the demand for incandescent lamps has been large in all sizes. The greatest output has continued as usual to be in the 25-watt to 60-watt sizes. The sales of gas-filled units, especially in the large sizes, has continued to increase rapidly and promises greater development. The lamps are now being used extensively for street lighting, and particularly for window illumination.

This being the holiday season, a large demand for miniature lamps was to be expected, but orders that came in late and which under ordinary conditions could be readily filled have this year been filled only with great difficulty and frequently not to the full extent of the order. While, of course, there is always a growing market for the miniature product for flashlamps and decorations, the sales this year of domestic goods have been by far the largest on record. The tremendous increase in the sale of domestic miniature lamps, of course, is attributable to the closing up of the foreign supply. Holland can still send lamps, but Germany, Austria and Belgium are to all purposes closed. On the other hand, the export of miniature lamps to foreign markets has been unprecedented.

The market for incandescent lamps has been growing now for some three or four months. Underlying this great buying movement are many causes. The chief cause, it is thought, is to be found in general business conditions. Because money is now easy, contractors, dealers, supply merchants and central stations are replenishing their already exhausted stock. During the past trying financial depression no buying to any extent other than that necessary to supply orders in hand was chanced. Everywhere stocks were allowed to run low in order to increase the liquid assets. Another cause is to be found in the increased industrial activity of the nation at large. The long hours made necessary by large orders on time contracts have increased the number of burn-outs. The need for machines and factory space, the building of many new factories for munition orders and the consequent needs for more artificial illumination have been responsible also to a large degree for present business. In addition to the above reasons, there is always, of course, the new-business activity on the part of the manufacturers.

Deliveries, in view of the amount of business on hand, are as good as can be expected. It has been difficult to get the new machinery made necessary by the increased output because machinery manufacturers, besides being overloaded, are handicapped by delayed deliveries of iron and steel. Owing to the freight congestion on the railroads, deliveries have been further delayed. Another serious drawback is the shortage of labor. Labor at the present time is practically at a premium. A further condition which is now being satisfactorily met, but which a few months ago threatened to be very serious, was that caused by the glass-bulb market. The glass manufacturers for a while were not able to satisfy the demand, and as a result the incandescent-lamp trade found it impossible to turn out the number of lamps that would have been possible had there been a sufficient supply of bulbs. This situation has now been cleared up in all but the special lines of glassware, in which deliveries are still very uncertain.

Credits, so far as could be learned, are still unchanged. Collections, it is said, are the best they have ever been. Good business and a plentiful supply of money have enabled the buyers of lamps to pay for their orders promptly.

In some quarters it is thought the peak has been reached, while in others it is thought that the curve of volume of orders is still ascending. It is, however, believed by all that the business will continue to show substantial increases over that of corresponding periods of previous years.

Woodmansee & Davidson, Chicago, Ill., engineers, have removed from the First National Bank Building to Suite 782-788, Continental and Commercial National Bank Building.

Chicago Manufacturer Moves to New Building.—The Minerallac Electric Company, formerly at 400 South Hoyne Street, Chicago, has moved into a new building which it has construsted at 1045 Washington Boulevard.

The Western Conduit Company, Youngstown, Ohio, has appointed R. J. Kaylor manager of its publicity department to take the place of J. P. Barrow, who has been transferred to the operating department of the company.

The Morse Chain Company, Ithaca, N. Y., has placed G. W. Pritchett in charge of the territory embracing North Carolina and South Carolina. Mr. Pritchett's headquarters will be at 805 Ashboro Street, Greensboro, N. C.

St. Francisville to "Light Up" with Oil Engines.—The town of St. Francisville, Ill., has recently contracted for an electric-lighting plant to be operated by two 60-hp. crude-oil engines made by the Muncie Oil Engine Company, Muncie, Ind.

The Macallen Company, Boston, Mass., has appointed A. Hall Berry, 97 Warren Street, New York, as its exclusive Eastern selling agent. Mr. Berry will have the territory embracing the New England States, New York, New Jersey and Pennsylvania.

The Anchor Electric Company of Chicago has recently been incorporated with a capital stock of $8,000. The concern will manufacture and deal in incandescent lamps. Gregory J. O'Kelly, Joseph L. Kennedy and Timothy J. Fell are the incorporators.

The Pennsylvania Steel Company and the Maryland Steel Company, Philadelphia, Pa., have appointed S. H. Smith as district sales manager of their Chicago territory, to succeed R. E. Delknap, who has been appointed district sales manager of their New York territory.

The Consolidated Electric Lamp Company, Danvers, Mass., manufacturer of incandescent lamps, has established a branch office in the Brady Building, Third Avenue and Ross Street, Pittsburgh, Pa., which will be in charge of S. C. Lyons, formerly manager of its New York office.

Campbell Scott, who has been for the past eleven years manager of the Otis Elevator Company's plant at Yonkers, N. Y., has resigned his position, the resignation to take effect on Dec. 31, 1915. Before joining the staff of the Otis Elevator Company Mr. Scott for eight years had been associated with the C & C Electric & Manufacturing Company of New York as secretary and general manager.

New Turbine Plant for Buffalo General Electric Company.—The Buffalo (N. Y.) General Electric Company has engaged the Stone & Webster Engineering Corporation of Boston, Mass., to design and build a new steam plant on the banks of the Niagara River, and construction will shortly be under way at full speed. The initial installation will consist of three 20,000-kw. generating units, and the cost of the plant will exceed $2,000,000.

New Engineering and Construction Firm Formed.—Fred A. Krehbiel and Edward N. Lake of Chicago have formed a new firm known as the Krehbiel Company, with offices at 1712 Marquette Building. Previously Mr. Krehbiel specialized in mechanical engineering and steam-plant construction and Mr. Lake devoted himself to electrical work. The new concern plans to design, finance, build or operate public-utility enterprises and to give advice on kindred projects.

Russian Company Wants Electrical Machines.—An interesting trade inquiry was recently received by the Department of Trade and Commerce, Ottawa, Canada, from a Russian company, which desires to enter into communication with first-class concerns manufacturing electrical machines and apparatus, insulating materials, steam and internal-combustion engines and water turbines, with a view to becoming their agents in Russia. The department is designating this query as Inquiry No. 1205.

The O'Brien Machinery Company.—C. J. O'Brien and F. L. O'Brien, formerly with Frank Toomey, Inc., have formed a company known as the O'Brien Machinery Company and have opened an office and salesroom at 107 North Third Street, Philadelphia, Pa. The company will handle a general line of machinery, including machine tools, steam and electrical equipment, woodworking machinery and supplies of all kinds. The company is also maintaining a warehouse and is prepared to store and overhaul all machinery before shipment.

Lamp Manufacturer Moves Into New Plant.—The H. J. Jaeger Company, Hoboken, N. J., manufacturer of gas-filled lamps for automobiles, has recently moved into its new plant at Weehawken, N. J. The new factory is 200 ft. long, 60 ft. wide and three stories high. The company announces that it is now prepared to turn out approximately 20,000 lamps per day, making the output about ten times that with the old plant. The company will also be engaged in the manufacture of standard gas-filled lamps for house and store lighting with ratings varying from 60 watts to 1000 watts.

Communicating Telephone System for Detroit Athletic Club.—One of the features of the new home of the Detroit Athletic Club is an "interphone" system designed by the Western Electric Company, 463 West Street, New York, which will do away with the "buzz and walk" systems now so frequently met with in club houses. The system has a capacity of sixteen stations, of which twelve have been installed and are in operation. Each station is equipped with a series of buttons, pressing one of which puts the person desiring to telephone in touch with the station wanted. As no operator is required, the upkeep cost of the system is practically nothing.

Sundh Company Notes Satisfactory Increase in Business.—The Sundh Electric Company, New York, manufacturer of electric starters and control apparatus, according to F. W. Smith, general manager of the company, has enjoyed very good business thus far this year, the increase in business for the first six months being 30 per cent over that for a similar period last year. The company's controllers are being used throughout in the Grant Telephone Building and the new William Penn Hotel of Pittsburgh. A complete installation of its automatic controllers has also been made in the plant of the Ward & Ward bakery of Buffalo. Sliding contacts have been eliminated from all control apparatus made by the Sundh company, Mr. Smith declares, butt contacts being used instead.

Preliminary Report on Boys' and Girls' Prize Contest for Edison Day.—The Edison Lamp Works of the General Electric Company, Harrison, N. J., have issued a preliminary report on their Edison Day prize contest for boys and girls. Over 500 agents and central stations participated in the contest, figures for twenty-seven of which are contained in the preliminary report as follows: Four hundred and thirteen contestants, 3,265,880 points, or watts; 7907 points per contestant; 198 40-watt equivalents per contestant; $53.46, list value per contestant; 281,647 40-watt equivalents for the twenty-seven companies, and $22,044.69, list value for the twenty-seven companies. The San Francisco office of the company has reported by telegram that 223 boy and girl contestants sold over 1,000,000 watts or points in the contest.

Holophane Works to Change Name.—On Jan. 1, 1916, the name of the Holophane Works of the General Electric Company, Cleveland, Ohio, will be changed to the Ivanhoe-Regent Works of the General Electric Company. The change has been necessitated because of the expiration on the above-named date of the contract through which the General Electric Company possessed the exclusive right to manufacture and sell Holophane prismatic glass. The General Electric Company will continue to manufacture and sell Regent glass and Ivanhoe metal reflectors. Although its right to handle Holophane prismatic glassware is no longer an exclusive one, it will continue to deal in the product. In their organization the Ivanhoe-Regent Works are in every respect the same as the concern hitherto known as the Holophane Works of the General Electric Company.

New Fleet of Electric Vehicles Appears in Chicago.—Reid, Murdock & Company, a Chicago grocery supply house, has just bought a fleet of about fifteen electric vehicles from the Walker Electric Vehicle Company. When asked why his company had decided to buy electric instead of gasoline vehicles, S. P. Stevens, sales manager of Reid, Murdock & Company, said that after fifteen months' competitive trial

the electric had proved itself superior to the gasoline vehicle. Although Reid, Murdock & Company is known as a grocery house that does little advertising, it has utilized the launching of its truck fleet as a medium for gaining wide publicity. Prior to the purchase of the trucks the company had circularized its agents, promising that on Dec. 22 the company would haul in an electric-vehicle parade in Chicago all of a certain commodity sold up to that date. On the day following the parade three 5-ton trucks loaded with the company's goods were dispatched from Chicago to Joliet, Aurora and Waukegan, Ill., to demonstrate the trucks' wide-travel range. The trucks were sold for the Walker Vehicle Company by John E. Dickson.

NEW YORK METAL MARKET PRICES

	Dec. 14 Selling Prices Bid	Asked	Dec. 21 Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot	76 12 6		84 5 0	
Prime Lake	19.25	to 19.50	20.12½	to 20.37½
Electrolytic	19.25	to 19.50	20.12½	to 20.37½
Casting	18.87½	to 19.12½	19.50	to 19.75
Copper wire base	20.75	to 21.00†	21.12½	to 21.37½†
Lead	5.40		5.40	
Nickel	....	to	45.00	to 50.00
Sheet zinc, f.o.b. smelter	22.00†		22.00†	
Spelter	....	to	17.55	to 17.80
Tin, Straits	37.75†		39.62½†	
Aluminum, 98 to 99 per cent	56.00	to 58.00	51.00	to 53.00
OLD METALS				
Heavy copper and wire	15.00	to 16.00†	16.00	to 16.50†
Brass, heavy	10.50	to 10.75†	11.00	to 11.25†
Brass, light	8.50	to 9.00†	9.00	to 9.25†
Lead, heavy	4.40	to 4.60†	4.75	to 4.87½†
Zinc, scrap	10.00	to 10.50†	11.00	to 12.00†

COPPER EXPORTS

Total tons to Dec. 21 23,505

†Nominal.

New Incorporations

The Pampa Water, Light & Power Company of Pampa, Tex., has been incorporated with a capital stock of $5,000 by A. E. Davis, M. E. Davis and E. Cantler.

The Electric Transmission Company of Pennington Gap, Va., has been incorporated with a capital stock of $100,000 by Arthur Hardgrave of Chicago, Ill., president, and B. F. Mays of Washington, D. C.

The Heartwell Water, Light & Power Company of Minden, Neb., has been granted a charter with a capital stock of $10,000. The incorporators are Leroy Sides, Alonzo Carter, F. L. Carrico, L. M. Robinson and Charles H. Gilson, Minden.

The World's Cheapest Power Company of Mechanicsburg, Pa., has been incorporated by W. A. Huber, A. G. Watkins and J. F. Huber, all of Mechanicsburg. The company is capitalized at $100,000 and purposes to operate water-power plants to generate electricity, etc.

New Industrial Companies

The Thistle Electric Company of Brooklyn, N. Y., has been incorporated by Willard D. Bass, Richard H. Fessler and Boyd Thistle, 340A Monroe Street, Brooklyn, N. Y. The company is capitalized at $10,000 and proposes to deal in electrical equipment, etc.

The Allied Equipment Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $250,000 for the purpose of manufacturing mechanical and electrical devices. The incorporators are George Rucker, Clair V. Rucker and William H. Peck, all of New York, N. Y.

The Precision Radio Equipment Company of Brooklyn, N. Y., has been incorporated with a capital stock of $5,000 by Simon H. Glass, Samuel H. Levy and Charles Horton, 230 Stuyvesant Avenue, Brooklyn, N. Y. The company purposes to manufacture and deal in electrical devices, wireless telegraph, telephone apparatus, etc.

Trade Publications

Roller Bearings.—The Hyatt Roller Bearing Company, Newark, N. J., is sending out an attractively illustrated colored folder which is of the "holiday greeting" type.

Lamp Guards.—The Electric Service Supplies Company, Seventeenth Street and Cambria Street, Philadelphia, Pa., has issued an illustrated folder on its portable lamp guards.

Metal Reflectors.—Harvey Hubbell, Inc., Bridgeport, Conn., is sending out an illustrated folder on its tin, aluminum, brass and enameled-steel reflectors for incandescent lamps.

Electric Timing System.—Bulletin No. 87 issued by the Betts & Betts Corporation, New York, contains information on its self-winding electric master clocks and secondary clocks.

Christmas-Tree Lighting Outfits.—The Anglo-American Company, Pittsburgh, Pa., is sending out an illustrated folder which lists various types of fancy lamps and novelties for Christmas-tree lighting.

Electric Contracting for Printers.—Edward B. Stott & Company, 227 Fulton Street, New York, are sending out an illustrated bulletin which contains information on electrical apparatus for printing.

Lighting Manual.—The Benjamin Electric Manufacturing Company, 120 South Sangamon Street, Chicago, Ill., is sending out a lighting manual which lists its various types of lighting fixtures and contains a large number of general illuminating data.

Electric Trucks.—The General Vehicle Company, Long Island City, New York, is sending out an illustrated folder entitled "How Much Does It Really Cost You to Operate Horses?" which outlines the advantages of electric vehicles over horse-drawn vehicles.

Protective Devices.—"Murray Protective Devices" is the title of a catalog prepared for the American Museum of Safety, 18 West Twenty-fourth Street, New York, and descriptive of apparatus manufactured by the Metropolitan Engineering Company, Forty-second Street Building, New York.

Electrically Operated Ventilating Apparatus.—"The Commercial Value of Washed Air" is the title of a catalog which contains a large collection of data on blowers and air-washing apparatus and on actual installations of the equipment, issued by the American Blower Company, Detroit, Mich.

Storage Batteries for Electric Vehicles.—Bulletin No. 151 issued by the Electric Storage Battery Company, Philadelphia, Pa., describes several types of batteries for industrial trucks and tractors, and Bulletin No. 152 contains information on "Exide" batteries for electric pleasure and commercial vehicles.

Violet-Ray Apparatus.—The Bleadon-Dunn Company of 208 North Fifth Avenue, Chicago, Ill., has brought out a thirty-two-page booklet describing and illustrating its Violetta high-frequency generators. The pamphlet also explains high-frequency phenomena in terms the layman can understand.

Corkboard Insulation.—The 1915 edition of a catalog entitled "Nonpareil Corkboard Insulation" and prepared by the Armstrong Cork Company, Pittsburgh, Pa., has just been brought out. The catalog is provided with a cardboard cover and contains numerous illustrations and diagrams and many data on corkboard insulation for refrigerating plants and heat-insulating purposes.

Lighting Installations.—The National X-Ray Reflector Company, Chicago, Ill., is sending out several attractively illustrated portfolio plates, Plate No. 41 of which gives the details of the construction of a projector unit used in illuminating the Woolworth Building tower in New York, Plate No. 42 contains information on the illumination of the armory of the University of Illinois at Urbana by means of "Jumbo" reflectors, Plate No. 29 gives details of the illumination of the interior of the St. Helena Cathedral, Helena, Mont., with X-ray reflectors, and Plate No. 37 illustrates how the "Jove" and "Jupiter" reflectors are used in the lighting of store windows.

New England

BAR HARBOR, ME.—The Bar Harbor & Union River Pwr. Co., Bar Harbor, contemplates the construction of an electric railway from Bluehill Falls to Brookline and Sedgwick, a distance of 14 miles. C. M. Tolman, Bangor, is chief engineer.

UNION, ME.—The Union Lt. & Pwr. Co. has petitioned the Public Utility Commission for permission to furnish electricity in Union. The company has also applied to the commission for authority to issue $6,000 in capital stock, the proceeds to be used for the purchase of certain franchises, rights and property from Hollis M. Shaw.

WATERBURY, VT.—The mill and dam on Little River, 4 miles from Waterbury, owned by L. J. Roberts, has been purchased by Craig E. Huntingale of New York, N. Y., who, it is understood, will develop the property to generate electricity. It is estimated that about 750 hp. can be developed.

SPRINGFIELD, MASS.—The three-wire overhead-trolley system of distribution will soon be adopted by the Springfield (Mass.) St. Ry. Co., according to a statement recently issued by C. V. Wood, president. The United States Bureau of Standards and the Stone & Webster Engineering Corpn., Boston, recently investigated the electrolysis situation at Springfield, and both reports recommended the sectionalizing of the trolley into alternative positive and negative portions and the virtual elimination of the rail return to the Margaret Street generating station. It was found desirable to adopt this system rather than to change over the plant for alternating-current transmission to substations. Reconstruction work will begin at once.

BRISTOL, R. I.—The Bristol County Gas & El. Co. is erecting a new high-tension transmission line from Warren to Bristol.

Middle Atlantic

AMSTERDAM, N. Y.—The Amsterdam Chamber of Commerce has taken the lead in the movement to secure a better street-lighting service for the city.

BELMONT, N. Y.—Plans are being considered by the Allegany County El. Lt. & Pwr. Co., recently incorporated, for the construction of a concrete dam in the Genesee River and the installation of an electric-power plant and a cold-storage plant in Belmont. The directors of the company are: James K. Harker, George W. Francis, C. H. C. Beakes, New York; Julius G. Berger, Potsdam, and Blakeley Graham, Chester, Pa.

BUFFALO, N. Y.—The International Ry. Co., Buffalo, it is reported, contemplates enlarging its substations, involving an expenditure of about $150,000.

BUFFALO, N. Y.—The Niagara, Lockport & Ontario Pwr. Co., which owns and operates electric transmission lines from the Niagara River to Lockport, Lackawanna, Batavia, Rochester and Syracuse, is stripping its towers of approximately 180 miles of aluminum wire and replacing it with copper wire.

DUNKIRK, N. Y.—The Atlas Crucible Steel Co., Dunkirk, has applied to the City Commissioners for an additional 1000 hp. to be supplied from the municipal electric plant. Inasmuch as this would necessitate the installation of additional equipment at the municipal plant, involving an expenditure of about $40,000, it is believed that the Niagara & Lake Erie Pwr. Co., Fredonia, will be asked to supply the energy through the city. The company is now supplied with 400 hp. by the city.

FILLMORE, N. Y.—The Genesee Valley Pwr. Co., Fillmore, is contemplating repairing a part of the open raceway of its hydroelectric plant with round-wood flume. H. G. Young is secretary.

GENEVA, N. Y.—The City Council has awarded a contract to the Central New York Gas & El. Co. for lighting the streets of the city for a period of five years. Ornamental lamps are to be used in the business district, and in the residential section the arc lamps (of which there are about 400) are to be superseded by 700 incandescent lamps.

LEBANON SPRINGS, N. Y.—The village of Lebanon Springs is contemplating the installation of an electric-lighting system.

NEW YORK, N. Y.—Bids will be received by the board of trustees of Bellevue and Allied Hospitals, 415 East Twenty-sixth Street, New York, until Dec. 27, for furnishing material and labor for the changes in the radiographic department of pavilion "K" of the new Bellevue Hospital. Blanks, forms and further information may be obtained at the office of the contract clerk and auditor, 400 East Twenty-ninth Street, New York.

OLEAN, N. Y.—Contracts have been awarded by the Olean El. Lt. & Pwr. Co. for equipment, including turbines, generators and boilers, sufficient to double the output of its plant. An addition will be built to the boiler room to accommodate the new boilers, which will be equipped with stokers, coal bunkers and coal-handling machinery. The company has entered into a contract to supply energy to the Dunlop Brothers' silk mills, which are now being enlarged, and to the Pennsylvania car and locomotive repair shops. Transmission lines are now being erected to both plants.

ALTOONA, PA.—The Penn Central Lt. & Pwr. Co. has started work on the erection of a transmission line from the St. Benedict substation in Cambria County to the new mines of the Duncan-Spangler Coal Mining Co. near Spangler, a distance of about 2½ miles. About 600 hp. will be furnished to the mine.

BUTLER, PA.—Surveys are being made by the West Penn Trac. Co., Pittsburgh, for extension of its electric lines in the Butler district. It is expected that the lines will be extended to the McFetridge coal mines, 7 miles north of Butler.

ERIE, PA.—The Erie Ltg. Co. has been granted a permit to build an addition to its plant, to cost about $10,000.

HARRISBURG, PA.—Notice has been given that application will be made to the Governor of Pennsylvania by S. D. Warriner, Rollin H. Wilbur and H. F. Baker, officials of the Lehigh & New England R. R. Co., for a charter for the Ruscomb Manor Township El. Co. for the purpose of supplying electricity for lamps, heaters and motors in said township. Application will also be made by the same parties for similar privileges in Rockland, Muhlenberg and Upper Alsace townships.

HARRISBURG, PA.—Charters have been granted to 19 public service companies by the State Department to supply electricity for lamps and motors in Butler County. Each company is capitalized at $5,000, and they are incorporated as the Adams, Allegheny, Brady, Center, Clay, Clearfield, Cherry, Concord, Donegal, Muddy Creek, Oakland, Slippery Rock, Venango, Washington and Worth Townships Lt. & Pwr. Companies. The incorporators are: J. W. Miller and R. M. Evans, Dormont, Pittsburgh, and E. S. Haymond, Wilkinsburg. The offices of the companies are in Pittsburgh. Charters have also been granted to the Noyes El. Lt. Co., Renovo, and the South Renovo El. Lt. Co., Renovo, each capitalized at $5,000.

PHILADELPHIA, PA.—Plans are being prepared for the construction of a power house and manufacturing plant, to be situated at American and Somerset Streets, for Hafleigh & Co. W. E. S. Dyer, Land Title Building, Philadelphia, is engineer in charge.

PHILADELPHIA, PA.—A large four-story stone, concrete and terra-cotta department-store building will be erected for Blauner & Co. at 833-835 Market Street. The building will be equipped with modern electrical apparatus throughout. The Hoffman Co., architect, Philadelphia, has charge of the work.

SPRING CITY, PA.—Bids have been asked for the construction of four new buildings for the Pennsylvania State Institute for the Feeble-Minded, to be erected in Spring City. Philip H. Johnson, Land Title Building, Philadelphia, is architect in charge.

SUNBURY, PA.—Rights of way, it is reported are being obtained for a third-rail electric-railway system throughout central Pennsylvania. According to J. F. Richard, fiscal agent of the Northumberland County Gas & El. Co., Sunbury, franchises will be asked in many towns in this section of the State. Starting at Scranton, the proposed railway will follow the west side of the Susquehanna to Sunbury. Recrossing the river, it is to follow the Susquehanna to Harrisburg. From Sunbury a line is to be built to Shamokin, Mount Carmel, Tamaqua and Hazleton, where it will connect with the Laurel third-rail system into Scranton. Energy to operate the system will be secured from the power plant of the Harwood El. Co., near Hazleton.

ATHENIA, N. J.—The Public Ser. El. Co. has begun work on the erection of a new substation at Van Houten Avenue and Pleasant Street, in the Athenia section of Acquackanonk Township. The building will be 50 ft. by 100 ft. and will be equipped with two 3000-kw. transformers. This station will distribute electricity generated at the Paterson and Marion plants of the company.

BUTLER, N. J.—Arrangements are

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

Two Power Plants Built to Carry Bulk Load

The Ohio State Power Company is building two generating stations within a mile of Fremont, Ohio. One is to be operated by water-power and one by steam. A substantial part of the output of both plants is under contract to the American Gas & Electric Company's Ohio property, the Ohio Light & Power Company, and to the Lake Shore Electric Railway Company. The former has contracted to use a minimum of 8,000,000 kw.-hr. a year, distributing it to Fostoria, Fremont, Tiffin and other cities, and the contract of the latter calls for the use of at least 17,000,000 kw.-hr. annually. Transmission circuits of the former company will operate at 66,000 volts and sixty cycles. Those of the latter company will operate at 19,100 volts and sixty cycles. This rather unusual potential has been selected so that substation apparatus which was formerly used on an 18,000-volt, twenty-five-cycle system can still be operated.

Both plants are on the Sandusky River, the steam plant being situated at the monolithic concrete dam and the hydroelectric plant being placed 3000 ft. down-stream. The most unusual features in the plants are the special underfeed stokers and the Allis-Chalmers reaction-type turbine which is used to drive auxiliary pumps. This machine is said to be the first of its type built in America. The plants were designed and are being constructed by Woodmansee & Davidson, engineers and contractors, Chicago, Ill.

being made by the City Council for supplying electricity for lamps and motors in Bloomingdale from the municipal electric-light plant in Butler.

JERSEY CITY, N. J.—The Board of City Commissioners is considering plans for the installation of additional street lamps on Ocean Avenue.

MAGNOLIA, N. J.—Plans are being considered by the Borough Council for the installation of an electric street-lighting system.

NEWTON, N. J.—The Board of Public Utility Commissioners has refused the application of the Newton Gas & El. Co. for permission to increase its rates and recommends the sale of the property of the company, which has been in the hands of William L. Keplinger, receiver, since Aug. 11, 1911.

MASON, W. VA.—The Ohio River Salt Co., it is reported, is contemplating the installation of an electric plant in connection with its works.

WHEELING, W. VA.—Bids will be received at the United States engineer's office, Wheeling District, Wheeling, until Jan. 22, 1916, for building fireproof power houses at Dams Nos. 16 and 17, Ohio River. Information on application.

WINCHESTER, VA.—Preparations are being made by the Northern Virginia Pwr. Co., Winchester, for the erection of a transmission line from Boyce to Riverton, via White Post. The power company will supply electricity to the Carson Lime Co. at Riverton to operate the machinery in the quarries there.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 5, 1916, for bronze lamp standards for the United States post office at San Francisco, Cal., and the United States post office at Stamford, Conn., and for other buildings under the control of the Treasury Department. Specifications and drawings may be obtained at the above office.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Washington, D. C., Schedule 9137—five outfits (condensers, tanks, valves, etc.); Schedule 9135—20,000 ft. cotton-covered lamp cord, 100 side-outlet current taps, 20,000 ft. double-conductor telephone wire; Schedule 9113—300 high-resistance telephone receivers; Schedule 9136—two diving engines, circular and straight-line, 100 sets stadimeter meters, 100 psychrometers and 50 pairs of thermometers for same. Brooklyn, N. Y., Schedule 9121—3000 sounding tubes; Schedule 9131—22,000 ft. interior communication cable, 1500 ft. telephone cable, 200,000 ft. plain double-conductor wire, 9000 ft. plain single-conductor wire, miscellaneous twin-conductor wire; Schedule 9118—six 1-kw. radio transmitting sets; Schedule 9139—250 fire-control telephones; Schedule 9124—357,000 ft. single and duplex rubber-covered wire, 3000 lb. weatherproof wire. Boston, Mass., Schedule 9135—5300 ft. single-conductor cable, etc. Portsmouth, N. H., and Mare Island, Cal., Schedule 9115—three 15-kw. generating sets. Applications for proposals should designate the schedule desired by number.

North Central

CHARLEVOIX, MICH.—The Rock Products Co., Charlevoix, has submitted a proposal to the City Council offering to supply electricity for the municipal electric-lighting system, the maximum price to be 4 cents per kw.-hr. The city has a contract with the Hydraulic Pwr. & Lt. Co., Bellaire, which does not expire until May 1, 1916.

DETROIT, MICH.—Application has been made by the Detroit United Ry. Co. to the State Railroad Commission for permission to issue $3,500,000 in bonds, of which the proceeds of $1,500,000 are to be used for extensions and improvements to its system.

WHITEHALL, MICH.—The Frugale Pwr. Co., Whitehall, is planning to enlarge its hydroelectric plant and will install two 200-hp. (each) waterwheels, and is open for bids on same; one waterwheel governor for above wheels, two 150-kw. (each), 60-cycle alternating-current generators, three complete switchboards, three step-up (13,200 volts) and three step-down (2200 volts) transformers, with total rating of 300 kva.; 300 30-ft. (6½-in. top) poles, 30 miles of No. 4 braided and stranded weather-proof wire, about 100 pole-type lightning arresters. Definite plans have not yet been decided upon. F. H. Speese, vice-president and manager, is in charge of the work.

BELLE CENTER, OHIO.—Bonds to the amount of $8,000 have been authorized for rebuilding the municipal electric-lighting plant.

CINCINNATI, OHIO.—Plans have been completed by the Ault & Wilberg Co. for the erection of a building on Cleneay Avenue, near the Chattanooga & Nashville Railway, for the manufacture of dyes. The installation of a 1000-hp. power plant is included in the project.

PIQUA, OHIO.—The property of the Miami Lt., Ht. & Pwr. Co., Piqua, has been taken over by the Dayton Pwr. & Lt. Co. Extensive improvements will be made to property of the Dayton Pwr. & Lt. Co. in Miami County, but as yet nothing definite has been decided upon.

SPRINGFIELD, OHIO.—Bids will be received by J. M. Pierce, auditor of Clark County, Springfield, for the County Commissioners until Dec. 30 for the installation of boilers and piping in the boiler room of the Clark County Memorial Building at Springfield. Plans and specifications are on file with Robert C. Gotwald, Springfield, architect.

ASHLAND, KY.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 24, 1916, for construction complete, including mechanical equipment and approaches, of the United States post office at Ashland, Ky.

NEWPORT, KY.—An ordinance is being prepared by the City Council which will provide for placing all overhead electric wires in underground conduits and for the installation of an ornamental street-lighting system, to be paid for by the property owners.

ANDERSON, IND.—A movement has been started by farmers on Pendleton Pike to secure electrical service from the Anderson municipal electric-light plant or the Union Trac. Co., Anderson.

ELKHART, IND.—Bids will be received by the City Commissioners, Elkhart, until Jan. 11, 1916, for lighting the streets of the city with electricity or gas. All electricity or gas is to be furnished at a meter rate, the meter to be placed at the source of supply.

TELL CITY, IND.—Bids will be received by Louis Siebert, city clerk, Tell City, until Dec. 28 for furnishing material and erecting 5 miles of three-phase transmission line from the power house in Tell City to the corporation limits of Troy.

BYRON, ILL.—The Byron El. Lt. & Pwr. Co., recently incorporated with a capital stock of $15,000, proposes to install an electric plant to supply electricity in Byron. William Vanston, George W. Sherman and others are interested in the company.

ANOKA, MINN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 18, 1916, for construction complete, including mechanical equipment (except lighting fixtures) and approaches, of the United States post office at Anoka, Minn.

CROOKSTON, MINN.—Bids will be received by the State Board of Control, State Capitol, St. Paul, Minn., until Jan. 20, 1916, for construction of a nurses' home in connection with the tuberculosis sanatorium for the counties of Polk and Norman, including general construction and mechanical equipment. Plans and specifications may be seen at the office of Sund & Dunham, architects, Essex Building, and Rose & Harris, engineers, Auditorium Building, Minneapolis, and also at the Builders' Exchanges, Minneapolis, St. Paul and Duluth, and at the office of Dr. Holte, Crookston.

DETROIT, MINN.—Bids will be received by the City Council until Jan. 3 for furnishing and installing three mechanical stokers in the municipal electric-light plant. E. J. Bestick is city clerk.

MAZEPPA, MINN.—Extensions and improvements to the municipal electric-lighting plant, involving an expenditure of about $10,000, are under consideration by the village of Mazeppa.

ST. PAUL, MINN.—The St. Paul Southern El. Co., it is reported, is contemplating the erection of a terminal building in St. Paul, to cost about $200,000. Adolph Hirschman is president of the company.

ST. PAUL, MINN.—Bids will be received at the office of the purchasing agent, Court House and City Hall, St. Paul, until Jan. 17, 1916, for designing, furnishing and erecting a steam pumping unit of 15,000,000 gal. capacity per 24 hours (against a total combined head of 171 ft. with steam pressure of 150 lb. per square in. at throttle), together with auxiliary equipment and appurtenances. Bids are invited on two types of pumping units, namely: (a) the centrifugal type of pump driven by a steam turbine through reduction gears, and (b) the triplex plunger type of pump driven by a vertical triple-expansion type of steam engine. Plans and specifications are on file in the office of August Hohenstein, purchasing agent.

DEFIANCE, IOWA.—The Council has awarded a contract to George Rossmann for lighting the streets of the town. Mr. Rossmann has an electric plant in his garage, which will be enlarged to supply electricity to maintain the street lamps.

DYERSVILLE, IOWA.—The property of the Dyersville Lt. & Wtr. Co. has been purchased by the Eastern Iowa Lt. & Pwr. Co., Anamosa. The local plant will be operated until connections are made with the high-tension line of the Eastern Iowa company, now being erected from Dubuque. The company is erecting a new substation at Epworth. The construction of a new overhead distribution system will be delayed until early spring.

GUTTENBERG, IOWA.—The town of Guttenberg has voted to install a municipal electric-light plant.

MUSCATINE, IOWA.—Plans are being considered for the installation of an ornamental lighting system in the business section of the city. Henry Wasserman is chairman of committee.

THORNTON, IOWA.—A stock company has been organized by local citizens to install an electric-light plant in Thornton. H. O. Case is president of the company, and A. L. Hemming is secretary.

ZEARING, IOWA.—The local electric-light plant, owned by Belden & Son, has been purchased by the Iowa Ry. & Lt. Co., Cedar Rapids. Next summer the system will be connected with the high-tension line being erected from Marhalltown to Colo and Ames.

BISBEE, N. D.—The Council, it is reported, has granted an electric company a 20-year franchise to install and operate an electric-lighting system in Bisbee.

LEOLA, S. D.—Bonds to the amount of $3,500 have been voted for extensions to the municipal electric-light plant.

DAWSON, NEB.—The Council is reported to have awarded a contract for the installation of a municipal electric-lighting system in Dawson. Energy for operating the plant will be obtained from the power station in Humboldt, owned by O. A. Cooper.

PLEASANT DALE, NEB.—Plans are being prepared by the Martz Engineering Co., First National Bank Building, Lincoln, for the installation of a municipal electric-light plant in Pleasant Dale, to cost about $5,000.

CIRCLEVILLE, KAN.—At an election held recently the proposal to issue bonds for the installation of a municipal electric-lighting plant was carried.

DODGE CITY, KAN.—The Midland Wtr., Lt. & Ice Co. will erect about 30 miles of transmission line and build two small substations to supply electricity in the towns of Bucklin and Ford. Energy will probably be transmitted at 13,200 volts. The company will be in the market for overhead-line material and transformers. The cost of the work is estimated at $25,000. Otto Theis is superintendent.

OAKLAND, KAN.—The installation of an electric-light plant in Oakland is reported to be under consideration.

PLAINS, KAN.—At an election to be held on Dec. 29 the proposal to issue $20,000 in bonds for the installation of an electric-light plant and water-works system in Plains will be submitted to the voters. H. W. Magruder, Liberal, Kan., is consulting engineer.

Southern States

ATLANTA, GA.—Bids will be received at the office of the superintendent of prisons, Department of Justice, Washington, D. C., until Jan. 4, for furnishing at the United States penitentiary, Atlanta, Ga., material required for electric-light, telephone and clock installations for the west main-cell wing. Copies of specifications, together with further information, may be obtained upon application to the above office. F. H. Duehay is superintendent of prisons.

JACKSONVILLE, FLA.—The Eagle Film. Mfg. & Producing Co. has purchased a site on Arlington Heights, on which it will erect a film-developing plant. The project will include an electric-light plant and water-works system. Equipment, it is understood, has been purchased. A. S. Roe, Chicago, Ill., is president of the company.

OKEECHOBEE, FLA.—Plans are being prepared by the Southern Utilities Co., Jacksonville, Fla., for the installation of an electric-light plant, water-works and sewer system, to cost about $50,000. The

proposal to issue bonds to provide funds for the work will be submitted to the voters.

ANNISTON, ALA.—The Alabama Pwr. Co., it is reported, has made arrangements to install an electric furnace for the manufacture of high-grade steel in Anniston. F. H. Chamberlain is general manager.

SUMNER, MISS.—The Sumner El. Lt. & Pwr. Co. has changed its name to the Southern El. Service Co. and increased its capital stock from $4,000 to $25,000.

WESSON, MISS.—Bids will be received by the town of Wesson until Jan. 4 for furnishing material and constructing an electric-light plant and water-works system, and also an artesian well, according to plans and specifications on file with the city clerk and M. L. Culley, engineer, Jackson, Mich., copies of which may be obtained upon deposit of $5.

OOLTEWAH, OKLA. — The Ooltewah Construction & Improvement Co. is planning to install a substation equipment to supply electricity for lamps and motors in Ooltewah. Energy to operate the system will be supplied by the Tennessee Pwr. Co.

SHAMROCK, OKLA.—The site for the proposed electric power plant which will supply electricity for the Sapulpa & Oil Fields R. R. has been located just south of Shamrock, on Spring Creek, where a large dam will be built. The plant will supply electricity to operate the machinery in the coal fields and also for lamps and motors in Shamrock. S. W. Barnes, Kansas City, Mo., is superintendent.

SAN ANGELO, TEX.—The Interstate El. Corpn., 115 Broadway, New York, N. Y., which owns the local electric and power plant, is considering the construction of an electric railway in San Angelo. J. D. Sugg, owner of the existing street railway, recently offered the system to the city as a gift, but it was refused. It is expected that it will be taken over by the Interstate company and the lines extended or an entirely new system built.

Pacific States

EVERETT, WASH.—F. L. Hammond, Everett, has filed with the county auditor a claim for a power site about a quarter of a mile east of the Dorgan place, on the Sultan River, to be used for the development of a hydroelectric plant. The claim is for 100,000 miners' in. of water.

LANGLEY, WASH.—The Town Council is contemplating calling an election to submit the proposal to issue bonds to purchase and improve the local electric-light plant and water-works system.

OKANOGAN, WASH. — The Okanogan Valley Pwr. Co., it is reported, has completed arrangements to extend its transmission lines along the Okanogan River between Okanogan and Malotte to supply energy for lamps and operating pumps for irrigation purposes. A deal has been closed by the company whereby it will lease one of the power plants of the government irrigation project that is now lying idle.

CONDON, ORE.—The electric plant of the Condon El. Co. has been sold to B. A. Bower, Condon. The new owner, it is understood, contemplates increasing the output of the plant and establishing a 24-hour service.

CORVALLIS, ORE.—An agreement has been reached between the City Council and the Southern Pacific Co. whereby the new tracks of the Southern Pacific Co. between Corvallis and Whiteson will be equipped for electrical operation.

STAYTON, ORE.—Preparations are being made by the Stayton El. Lt. Co. to enlarge its power plant to enable it to extend its service to Sublimity, where the company was recently granted a 25-year franchise and awarded a five-year contract for street-lighting. The company will install a new waterwheel and generator (possibly two) and change its system from single-phase, 133 cycles, to three-phase, 60 cycles. Contracts have not yet been placed for all of the machinery. C. E. Taylor is owner and general manager.

BERKELEY, CAL.—Specifications have been approved by the City Council for lighting a district including everything south of Derby Street and east of College Avenue, and plans for the creation of another district to take in the section north of the University of California campus are being prepared. It is proposed to light the city under a district plan.

FRESNO, CAL.—The Fresno Interurban R. R. Co. will construct during 1916 an electric railway from Fresno to Clovis and Fresno to Centerville, a total of 18½ miles.

RIVERSIDE, CAL.—The contract for installing 444 concrete posts (one lamp) in what is commonly known as the "East Side" has been awarded to the City El. Sup. Co., Riverside, at $12,915.

OGDEN, UTAH.—The Ogden, Logan & Idaho Ry. Co. expects to construct an electric railway from Ogden to Harrisville and from Hot Springs to Brigham City, a total of 22 miles.

SALT LAKE CITY, UTAH.—A site has been secured at South and West Temple Streets by the Salt Lake & Utah El. Ry. and the Salt Lake & Ogden El. Ry. Cos. on which a joint terminal depot will be erected, to cost about $200,000.

BILLINGS, MONT.—Plans for the proposed power and irrigation project of the Big Horn Irrigation & Pwr. Co. provide for the construction of a large dam, a 170,000-hp. hydroelectric power plant, railroad from Custer, Mont., to cost $800,000; ditches, laterals, etc. The total cost of the work is estimated at $12,000,000. J. J. Harris, Hardin, is president of the company.

ALBUQUERQUE, N. M.—Plans are being prepared by A. G. Hillberg, 13 Park Row, New York, N. Y., for the construction of a 30,000-hp. hydroelectric plant at the mouth of White River Canyon on the Rio Grande River in New Mexico, to cost about $2,000,000. Charles G. Wilfong, Philadelphia, Pa., is president of the company.

Canada

COBDEN, ONT.—A by-law authorizing an appropriation of $20,000 for the construction of an electric generating plant and an electric distribution system in Cobden will be submitted to the ratepayers on Dec. 27.

SARNIA, ONT.—A by-law providing $120,000 for the purchase of the electric generating plant and distributing system of the Sarnia Gas & El. Co. and for remodeling the same will be submitted to the ratepayers on Jan. 3, 1916.

SMITH'S FALLS, ONT.—The Town Council has awarded the contract for street-lighting to the Smith's Falls El. Pwr. Co. for a period of five years. The new contract provides for the installation of 50 200-watt nitrogen-filled lamps in the business section and 200 100-watt nitrogen-filled lamps in the residential districts, all to be erected on pole brackets. The company is allowed nine months to install the new system.

HULL, QUE.—Extensions to the lighting system, to cost about $20,000, are under consideration by the City Council.

REGINA, SASK.—The City Council, it is reported, has decided to install an electrically driven pumping plant at Boggy Creek, to cost about $12,000. The plans include the erection of about 10 miles of overhead transmission line.

Miscellaneous

HONOLULU, HAWAII.—Bids will be received by the Board of Harbor Commissioners, Capitol Building, Honolulu, until Jan. 7 for furnishing and installing electrical equipment for handling sugar machinery at Kuhio Wharf, Hilo, Hawaii.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 8, 1916, for furnishing steel, iron, chain, steel cable, wire, cable clips, bronze, brass, copper, copper tubing, brass tubing, etc. Blanks and general information relating to this circular (No. 998) may be obtained from the above office or the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

Record of Electrical Patents

Notes on United States Patents issued Dec. 14, 1915, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,163,631. RAILWAY SWITCH OR THE LIKE; C. O. Anderson, Omaha, Neb. App. filed Oct. 16, 1909. Controlled from central point.

1,163,656. NEUTRALIZER; W. S. Hadaway, Jr., New Rochelle, N. Y. App. filed Oct. 23, 1913. For static charges.

1,163,657. VAPOR HEATER; W. S. Hadaway, Jr., New Rochelle, N. Y. App. filed Oct. 23, 1913. Steam cooker.

1,163,658. SOCKET; W. S. Hadaway, Jr., New Rochelle, N. Y. App. filed May 8, 1914. Attachable to sheet-metal plate.

1,163,659. METHOD OF PRODUCING ELECTRIC HEATERS; W. S. Hadaway, Jr., New Rochelle, N. Y. App. filed May 14, 1914. Rugged construction for soldering irons.

1,163,664. DIRECTIONAL CURRENT ARRESTER; P. C. Hewitt, New York, N. Y. App. filed Feb. 3, 1903. Mercury rectifier.

1,163,665. PROTECTING DEVICE FOR VAPOR APPARATUS; P. C. Hewitt, New York, N. Y. App. filed Jan. 11, 1906. Chamber prevents short-circuiting.

1,163,666. VAPOR-ELECTRIC APPARATUS; P. C. Hewitt, Ringwood Manor, N. J. App. filed June 5, 1908. Two receiving circuits.

1,163,678. DUPLEX WEIGHER; E. H. Messiter, Brooklyn, N. Y. App. filed Feb. 7, 1914. For traveling conveyers.

1,163,685. SNAP SWITCH; T. LeR. Parker, Chicago, Ill. App. filed Oct. 19, 1914. Special detent mechanism.

1,163,688. CONTROLLING DEVICE; C. M. Rice, Milwaukee, Wis. App. filed Oct. 12, 1914. For motor-driven rheostats.

1,163,703. CONNECTION FOR ELECTRICAL TERMINALS; A. C. Taylor, Warren, Ohio. App. filed June 26, 1913. For welding machines.

1,163,705. VAPOR CONVERTER; P. H. Thomas, Montclair, N. J. App. filed Jan. 13, 1905. New arrangement of positive electrodes.

1,163,706. METHOD OF OPERATING VAPOR-ELECTRIC APPARATUS; P. H. Thomas, Montclair, N. J. App. filed Nov. 4, 1907. Maintains negative electrode continuously operative.

1,163,707. SINGLE-PHASE GAS OR VAPOR-ELECTRIC APPARATUS; P. H. Thomas, Montclair, N. J. App. filed June 13, 1903. Supplies extra initial potential.

1,163,708. MERCURY-VAPOR APPARATUS; P. H. Thomas, Upper Montclair, N. J. App. filed Sept. 12, 1912. Operated at relatively high pressure.

1,163,720. RAILWAY SIGNALING; H. A. Wallace, New York, N. Y. App. filed June 23, 1914. For limiting traffic on bridges.

1,163,762. COMPOSITE ELECTRIC SYSTEM; A. D. T. Libby, Elyria, Ohio. App. filed Jan. 12, 1911. Telephone and police system.

1,163,765. ELECTRIC COUNTER ATTACHMENT FOR ROTARY METERS; E. H. Messiter, Brooklyn, N. Y. App. filed March 22, 1912. Rotation counter.

1,163,768. TUBULAR OZONE GENERATOR; M. P. Otto, Paris, France. App. filed Sept. 18, 1913. Uses cooling water.

1,163,783. AUTOMATIC ALARM LOCK; M. Sheinman, New York, N. Y. App. filed June 1, 1914. Bolt carries movable contact.

1,163,834. PRIMARY BATTERY; H. E. R. Little, New York, N. Y. App. filed May 15, 1914. Continuously supplied gas forms one active element.

1,163,839. GROUND-RECEIVING OUTFIT; C. E. Mellon, Coatesville, Pa. App. filed Aug. 12, 1913. Improved wiring connection for wireless.

1,163,852. TELEPHONE SYSTEM; R. L. Quass, New York, N. Y. App. filed May 1, 1914. Interconnecting central offices.

1,163,883. SELECTIVE SIGNALING DEVICE; J. P. C. Boswau, New York, N. Y. App. filed July 10, 1913. For telegraph lines.

1,163,887. ELECTRIC HAND LANTERN; C. F. Burgess, Madison, Wis. App. filed March 30 1915. Attachable to binding post of dry cell.

1,163,896. SIGNALING SYSTEM; H. L. Darrah, Chatham, N. J. App. filed Aug. 12, 1913. For telegraph or telephone work.

1,163,899. TELEPHONE SYSTEM; A. H. Dyson, Montclair, N. J. App. filed March 31, 1914. Connecting switches controlled over the two-line wires.

1,163,900. TELEPHONE SYSTEM; A. H. Dyson, Montclair, N. J. App. filed March 31, 1914. Controlling of switches.

1,163,903. ELECTROMAGNETIC DEVICE; O. F. Forsberg, New York, N. Y. App. filed Sept. 29, 1909. Combined jack and signal.

1,163,904. Terminal Mounting for Metallic Spools; O. F. Forsberg, Yonkers, N. Y. App. filed Dec. 7, 1914. Terminals rigidly secured to spool head.

1,163,911. Electrolysis; C. A. Hall, Mount Airy, Pa. App. filed March 6, 1913. Uses compound in electrolyte which combines with liberated anions to form a passive compound.

1,163,918. Vehicle Signal; C. Heidemann, St. Louis, Mo. App. filed April 20, 1914. Lighted semaphore arm.

1,163,953. Automatic Call-Distributing System; J. G. Roberts, Dobbs Ferry, N. Y. App. filed June 26, 1913. Operates instantly and with precision.

1,163,957. Plunger Switch Key; O. A. Shann, Brooklyn, N. Y. App. filed Dec. 6, 1913. Plungers freely rotatable.

1,163,959. Stereoscopic X-Ray System; H. C. Snook, Cynwyd, and E. W. Kelly, Philadelphia, Pa. App. filed Aug. 15, 1912. Plurality of anti-cathodes.

1,163,960. Electrical System of Distribution; W. A. Turbayne, Lancaster, N. Y. App. filed Nov. 24, 1908. Train lighting.

1,163,972. Lighting - Fixture Shade Holder; A. W. Clarke, Jeffersonville, Ind. App. filed June 17, 1914. Constructed to withstand vibration of train.

1,163,973. Railway Signaling System; C. J. Coleman, N. Y. App. filed Aug. 7, 1909. For electric railways.

1,163,991. Secondary or Storage Battery; B. Ford, Philadelphia, Pa. App. filed May 21, 1913. For submarines; guards against escape of gas.

1,163,992. Automatic Filler and Vent for Storage Batteries; B. Ford, Philadelphia, Pa. App. filed Dec. 19, 1912. Prevents introduction of more than proper amount of liquid.

1,163,993. Secondary or Storage Battery; B. Ford, Philadelphia, Pa. App filed June 16, 1914. Vent and liquid seal.

1,163,996. Automatic Switch; H. Grob, Zurich, Switzerland. App. filed Dec. 28, 1908. For axle-driven generators.

1,163,997. System of Electrical Distribution; F. W. Harris, Wilkinsburg, Pa. App. filed May 16, 1910. For trolley or third-rail systems.

1,164,001. Electric Circuit Controller; H. D. James, Pittsburgh, Pa. App. filed May 23, 1908. For small motors such as are used for textile machinery.

1,164,009. Electric Welder; J. A. Osborn, St. Louis, Mo. App. filed June 17, 1913. For spot-welding of car constructions.

1,164,015. System of Electrical Distribution; K. C. Randall, Edgewood Park, Pa. App. filed Sept. 12, 1910. Proportioning load carried by motor-generator sets.

1,164,032. Electrical Measuring Instrument; P. Thomas, Wilkinsburg, Pa. App. filed Dec. 4, 1913. Potentiometer.

1,164,035. Electrical Controlling System; E. Tobiessen, Milwaukee, Wis. App. filed Nov. 30, 1910. Prevents overheating of dynamo-electric machines.

1,164,038. Electric-Motor Controller; T. Varney, Pittsburgh, Pa. App. filed Sept. 18, 1911. Includes a pilot motor.

1,164,045. Automobile Signaling Device; Van Der Veer Willing, Philadelphia, Pa. App. filed Nov. 26, 1913. Solenoid-operated signal.

1,164,049. Treatment of Pyrite or Other Iron Sulphides; L. T. Wright, London, Eng. App. filed Nov. 18, 1912. Subjected to 3000 deg. C.

1,164,069. Call Box; A. A. Clokey, Jersey City, N. J. App. filed June 23, 1915. Improved adjustable break wheel.

1,164,101. Apparatus for Curling Hair; G. Kremer, New York, N. Y. App. filed Dec. 4, 1913. For curling and treating the roots of the hair.

1,164,113. Sparking Plug; I. C. Orswell, Hyde Park, Mass. App. filed April 26, 1907. With induction coil.

1,164,148. Lock Device of Fuse Blocks or Cut-Outs; C. S. Walton, Los Angeles, Cal. App. filed Oct. 12, 1914. For preventing surreptitious closing of circuit.

1,164,159. Fluid-Controlled Electric Regulator; E. V. Anderson, Monessen, Pa. App. filed Nov. 25, 1912. For maintaining a level or pressure in a tank.

1,164,187. Apparatus for Treating Ores and Other Materials Under Pressure; H. B. Hovland, Duluth, Minn. App. filed May 27, 1915. Sulphating ores.

1,164,191. Knife Switch; H. F. Johaningmyer, St. Louis, Mo. App. filed May 6, 1914. Large contact areas.

1,164,205. Electric Chair; J. J. Odenwald, Washington, D. C. App. filed April 8, 1915. Shocking apparatus concealed in seat of chair.

1,164,213. Sequence Switch; J. N. Reynolds, Greenwich, Conn. App. filed March 1, 1913. For effecting a large number of circuit changes.

1,164,223. Stabilized Commutator Machine; A. Scherbius, Baden, Switzerland. App. filed Aug. 1, 1910. Runs as a self-exciting machine.

1,164,236. Electrical Outlet Box; H. E. Svenson, New York, N. Y. App. filed Aug. 19, 1914. Has clamps for armored cable.

1,164,246. Electrical Measuring Instrument; A. P. Young, Dovedale, near Rugby, Eng. App. filed Nov. 29, 1913. Mercury-motor type.

1,164,249. Swivel Attachment Plug; C. J. Alpaugh, Trenton, N. J. App. filed March 22, 1915. Swivel part frictionally held on other part.

1,164,254. Method of Shaping Wire Ends; F. G. Breul, Bridgeport, Conn. App. filed Jan. 24, 1914. For welding purposes.

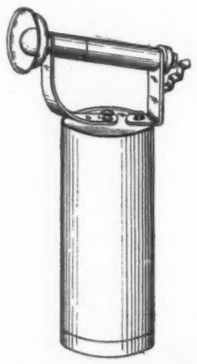
1,164,257. Circuit-Interrupting Device; E. R. Carichoff, Schenectady, N. Y. App. filed Dec. 26, 1912. Arc extinguisher.

1,164,259. Cut-Out and Release for Air-Brake Apparatus; S. P. Cota, Portland, Ore. App. filed March 2, 1914. Indicates conditions of brakes to train crew.

1,164,260. Reversible Brush Holder for Dynamos; J. L. Creveling, N. Y. App. filed Sept. 25, 1911. Car lighting.

1,164,261. Reversible Brush Holder for Dynamo-Electric Machines; J. L. Creveling, New York, N. Y. App. filed Oct. 20, 1911. Uniform polarity regardless of rotation.

1,164,262. Reversible Brush Holder for Dynamo-Electric Machines; J. L. Creveling, New York, N. Y. App. filed Nov. 3, 1911. Includes electromagnetic connecting means.



1,163,887—Electric Hand Lantern

1,164,263. Reversible Brush Holder for Use with Dynamos; J. L. Creveling, New York, N. Y. App. filed Feb. 12, 1912. Electromagnetic arresting means.

1,164,271. Progressively Movable Electric Switch and Controlling Mechanism Therefor; B. G. Dunham, Rochester, N. Y. App. filed Jan. 2, 1908. Progressively moved wipers.

1,164,273. Relay and Repeater; W. Finn, Bloomfield, N. J. App. filed Dec. 21, 1914. High-speed operation.

1,164,274. Telegraph Repeater; W. Finn, Bloomfield, N. J. App. filed Feb. 3, 1915. "Back-contact" high speed.

1,164,278. Metal Working; H. Geisenhoner and E. F. Collins, Schenectady, N. Y. App. filed Aug. 14, 1914. Butt-welding conductive bars of rotor.

1,164,280. Storage-Battery System; E. A. Halbleib and F. F. Dorsey, Rochester, N. Y. App. filed Feb. 8, 1913. For vehicles.

1,164,282. Protective Device for Searchlights; G. Hennings, Pankow, Germany. App. filed March 18, 1915. Segmental screen prevents deposit on reflector.

1,164,291. Electric Motor-Starting Rheostat; C. Kosnick, New York, N. Y. App. filed July 30, 1914. Avoids injurious arcs.

1,164,297. System of Control; R. H. McLain, Schenectady, N. Y. App. filed Feb. 8, 1912. Compensation for voltage drop.

1,164,298. Automatic Train-Line Coupling; G. Macloskie, Schenectady, N. Y. App. filed July 22, 1911. Cable coupler for electric cars.

1,164,302. Split-Pole Induction Motor; J. S. Mueller, Chicago, Ill. App. filed June 24, 1907. Self-starting under split-phase excitation.

1,164,313. Contact Device for Interrupters; A. Pollak, Paris, France. App. filed March 18, 1913. Contacts have a wiping movement.

1,164,317. Ignition System for Ford Automobiles; H. B. Snell, South Bend, Ind. App. filed July 19, 1915. Includes a synchronizer.

1,164,320. Circuit-Breaker; A. M. Taylor, Birmingham, Eng. App. filed March 18, 1911. Quick-operating.

1,164,323. Weight Motor; G. C. Andrews and L. V. Barnes, Minneapolis, Minn. App. filed March 20, 1912. For thermostatic control of furnaces.

1,164,330. Block Signal System; T. Bodde, Westfield, N. J. App. filed Sept. 19, 1907. Track rails electrically continuous.

1,164,349. Switch Box; P. M. Hotchkin, Chicago, Ill. App. filed Nov. 23, 1914. Fits in the framework of a showcase.

1,164,356. Electromagnet; C. A. Kaiser, Philadelphia, Pa. App. filed Sept. 10, 1913. For imparting heat, vibration and magnetism to portions of the body.

1,164,366. Travel-Indicating Signal for Automobiles; A. J. Lamb, Brooklyn, N. Y. App. filed Oct. 4, 1913. Operated from steering post.

1,164,407. Telephone Relay; J. Schiessler, Baden, near Vienna, Austria-Hungary. App. filed July 2, 1913. Special arrangement of incandescent resistance.

1,164,432. Ignition System; R. Varley, Englewood, N. J. App. filed Nov. 17, 1914. Combined magneto and battery system.

1,164,440. Electric Binding Post; R. K. Witz, Chicago, Ill. App. filed July 1, 1911. Wire is inserted in hole through binding screw.

1,164,446. Electric Switch; C. E. Anderson, Bridgeport, Conn. App. filed May 8, 1915. Double push-button.

1,164,464. Treatment of Storage-Battery Plates; C. C. Carpenter, Buffalo, N. Y. App. filed March 8, 1910. Immerses formed plate in solution of a persulphate of an alkaline earth.

1,164,475. Automatic Mallet or Plugger; G. Croston, Hoquiam, Wash. App. filed July 23, 1914. For dentists.

1,164,479. Automatic Telephone-Exchange System; G. Deakin, Berkeley, Cal. App. filed Oct. 26, 1911. Combined selector and connector switch.

1,164,507. Signal Control; J. B. Guyer, N. Y. App. filed Jan. 17, 1914. Automatic break when signal is actuated.

1,164,511. Electric Clock; F. Hardisty, Frankfort, Ind. App. filed Dec. 17, 1914. Pendulum breaks circuit immediately after impulse.

1,164,514. Automobile Indicator and Signal; J. B. Healey and H. E. McKinley, Brooklyn, N. Y. App. filed Jan. 5, 1915. Includes a rotatable signal arm.

1,164,517. Counter Torque-Exerting Device; W. S. Henry, Rochester, N. Y. App. filed July 17, 1912. For railway signals.

1,164,524. Disconnective Switch; B. G. Jamieson, Chicago, Ill. App. filed Jan. 23, 1915. Disconnected portion free from potential.

1,164,547. Automobile Signal; F. Rauscher, Port Richmond, N. Y. App. filed May 1, 1915. Signal arms projected at edge of dash.

1,164,557. Master Clock; W. F. Straub and A. A. Radtke, Chicago, Ill. App. filed Feb. 11, 1913. Periodically winds itself.

1,164,563. Guard for Cords or Wires of Telephone Sets; O. Yates, Sr., Portland, Ore. App. filed July 22, 1914. Cord is supported on the standard of portable telephone set.

1,164,572. Electric Signaling Device; C. Brandon, Indianapolis, Ind. App. filed Feb. 3, 1915. Indicates dangerous temperature of water in engine-cooling system.

1,164,588. Self-Propelled Vehicle; J. B. Entz, Hartford, Conn. App. filed Feb. 24, 1908. Electric drive system.

1,164,602. Time-Controlled Mechanism; W. H. Greenleaf, Hartford, Conn. App. filed Jan. 14, 1915. For winding a timepiece.

1,164,603. Electric-Vapor Lamp and the Like; J. Jonas, Baden, Switzerland. App. filed Sept. 25, 1914. Magnetically influences electric arc in metal vacuum vessel.

1,164,611. Inductor; A. B. Herrick, New York. App. filed May 20, 1912. Prime cord surrounded by primary and secondary windings.

1,164,614. Filament for Incandescent Lamps; F. G. Keyes, East Orange, N. J. App. filed Feb. 17, 1915. Tungsten with high radiating surplus.

14,031 (reissue). Commutator Motor; H. K. Schrage, Vesteras, Sweden. (Original patent No. 1,079,994, filed Dec. 2, 1913.) Secondary member has a non-interlinked polyphase winding.

The Power of the Easy-Payment Plan in Electric-Appliance Sales—*and other articles for the Electrical Business Man and Engineer*

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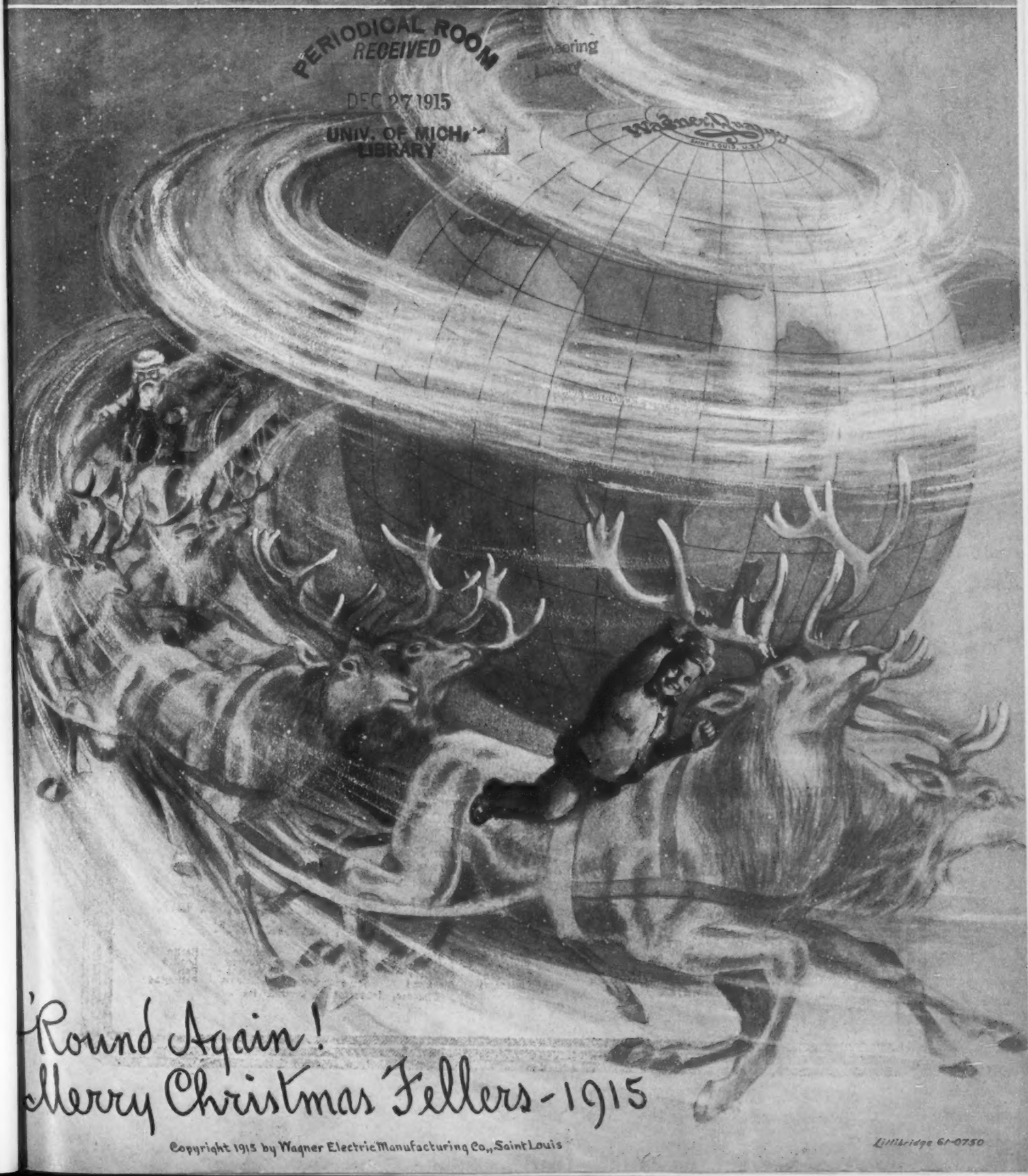
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For complete information regarding Model 329 Polyphase Wattmeters and Model 310 Single-Phase and Direct Current Portable Wattmeters, write for Bulletin No. 2002. Other Models in this group are Model 341 A.C. and D.C. Portable Voltmeter, described in Bulletin No. 2004; and Model 370 A.C. and D.C. Portable Ammeter, described in Bulletin No. 2003.

Weston Portable Instrument Transformers are described in Bulletin 2001

Model 341
A. C. and D. C. Portable Electrodynamometer
VOLTMETER

Model 310
Single-Phase and Direct Current Portable Electrodynamometer
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Model 370
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Electrical World

New York, December 25, 1915

Volume 66, No. 26. Pages 1403-1458

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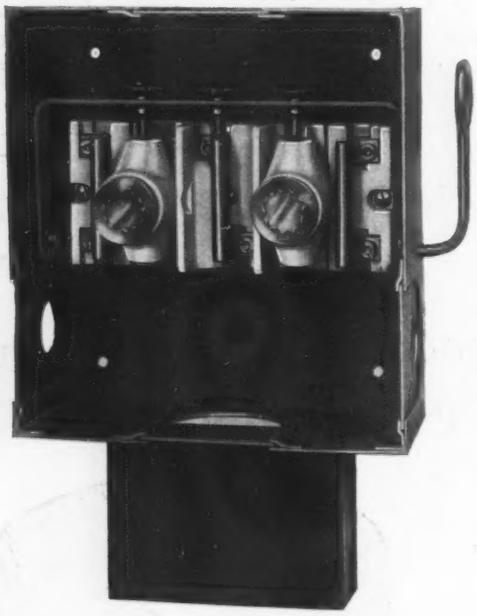

One of the many Noark Service devices built up of units. The cabinet, the porcelain fuse blocks, fuse units, and the operating handle are all optionally interchangeable.

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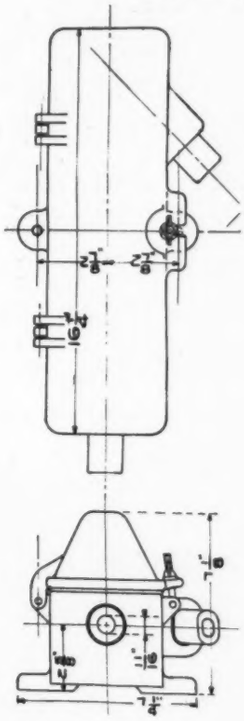

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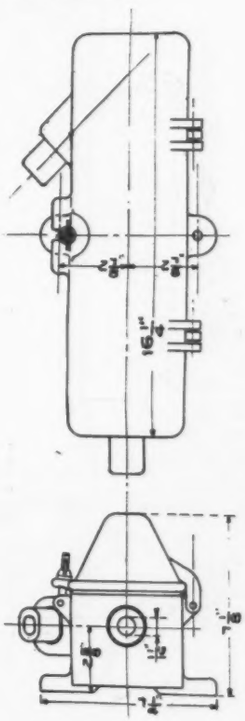

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In your factory it makes the work of your employees easier and speeds up production.

Installed in your home it reduces light bills and adds to your comfort.

If you can use suggestions regarding the sale or use of National MAZDA lamps write to any of the Sales Divisions represented by the labels below or to Lamp Headquarters.

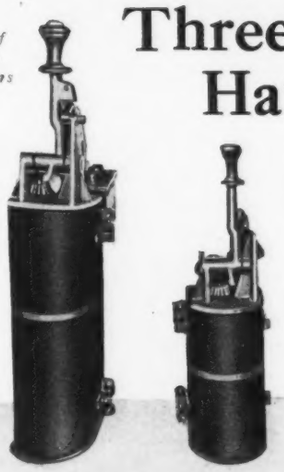
National MAZDA— ***The Way to Better Light***

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK, CLEVELAND

Member Society for Electrical Development. "Do It Electrically."

CUTLER-HAMMER

Types of Master Controllers Used

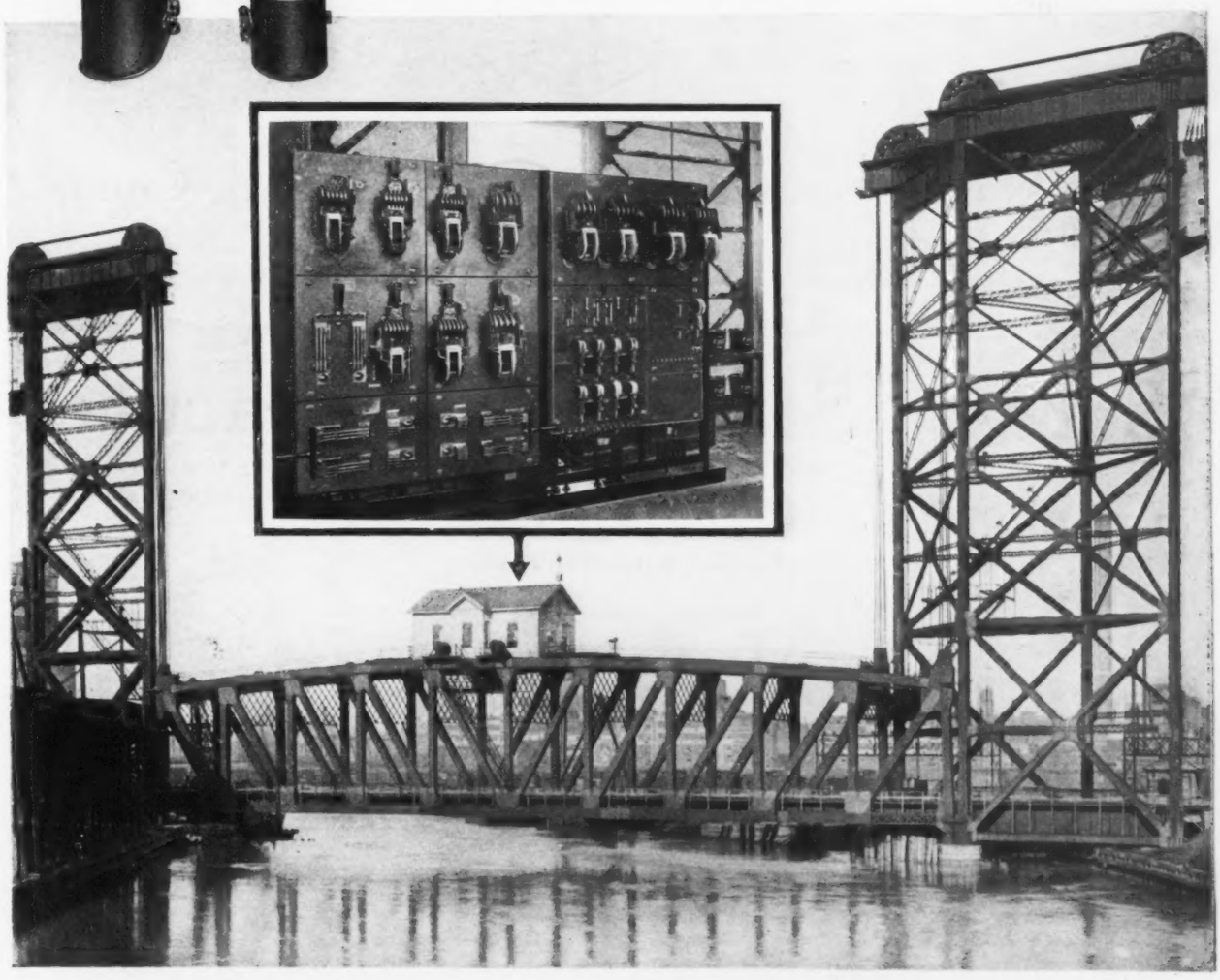


Three Big Chicago Railroad Bridges Have Cutler-Hammer Controllers

One of three big double track railroad bridges over the Calumet River, Chicago, is shown below. This was built during the early part of 1914. Cutler-Hammer Controllers were installed.

Recently two more bridges of similar construction have been completed, and you will find Cutler-Hammer Control Panels and Master Controllers in the operators' cabins of each bridge.

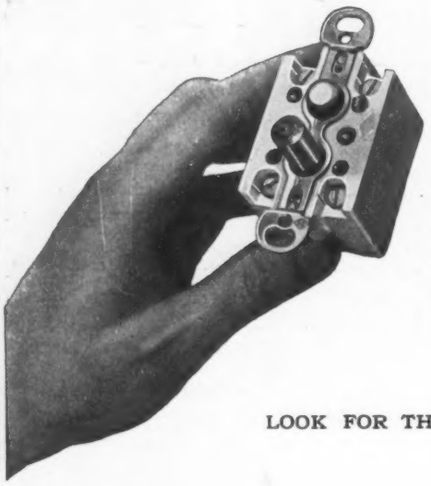
Railroad bridge service requires the most reliable operation and control. The 1550 H.P. of motors used for these Chicago bridges are readily and reliably controlled by the manipulation of the Cutler-Hammer Masters.



THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: Hudson Term. 50 Church St. CHICAGO: Peoples Gas Bldg. PITTSBURG: Farmers' Bank Bldg. BOSTON: Columbian Life Bldg.
PHILADELPHIA: Commonwealth Bldg. CLEVELAND: Schofield Building CINCINNATI: Gwynne Building
PACIFIC COAST AGENT: H. B. Squires Co., 579 Howard St. SAN FRANCISCO, San Fernando Bldg., LOS ANGELES and Morgan Building, PORTLAND, ORE.

"Diamond H" Construction



If for no other reason than the exclusive "Diamond H" enclosed mechanism this switch would be worth far more than the stamping-machine made switch.

That is but one of the "Diamond H"' superior points—the straight line movement, the rustproof construction, the solid machine screw binding posts all contribute to bigger value, bigger service, bigger satisfaction to the user.

Few men can afford to risk their reputation on a choice of a second best swich.

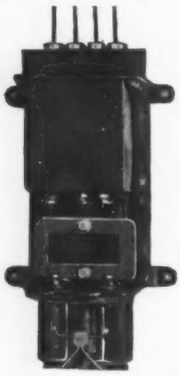
SPECIFY "DIAMOND H" AND

LOOK FOR THIS TRADE MARK ON EACH SWITCH

The Hart Manufacturing Co., Hartford, Conn.

Sound "Safety First" Practice

For Polyphase Motor Driven Machinery



Reverse Phase Relay

Prevents dangerous accidental phase reversal during repairs to machinery or lines.

For Equipment and Men in High Tension Feeder Ammeter Testing

Franklin Instrument Cut-Out Switches

Transformer Secondaries are short-circuited when the meter is cut out. No transformer explosions.

For Transformer Service

Franklin Air Pressure Relay

The blower motor must keep going or the Relay sounds the alarm through the station.

Philadelphia Electric Company Supply Dept.

132 South Eleventh Street, Philadelphia

The *On-Time* Advertiser

who gets his copy and cuts to us well before the day his advertisement should go to press, gets better type composition, better location and a better opportunity to make necessary corrections on the proofs which can then be submitted before publication.

The *Last-Hour* Advertiser

whose copy and cuts come in at the last minute or even later, gets the best attention we can possibly give. We work overtime to do what we can for him. But the lack of sufficient time makes it physically impossible to do as well for him as for the advertiser whose instructions come in well before the last hour.

Get Your Copy and Cuts in *Early*

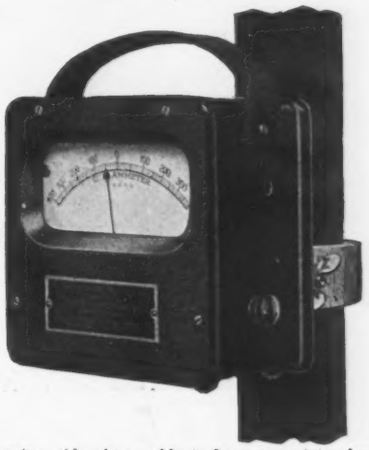
Do this, not on our account, but for the sake of your own advertising. We want to serve all advertisers equally well — but we can't put more hours into a day, and the advertiser who gives us the most time gets the best results.

Copy and cuts should be in our hands by Friday of the week preceding the date of issue. This means that Friday is the **last** day on which changes of copy can be handled normally.

For good advertising, get your cuts and copy in every week **before** Friday.

Electrical World
239 West 39th Street, New York

DON'T GUESS



No. 70 ammeter, side view, cable to be measured is placed within the removable iron loop

Know in an instant the amount of current flowing in your networks, cables, feeders, etc., without opening the circuit, by using a

Metropolitan D. C. Cable Testing Ammeter

DO YOU WANT TO:

1. Measure current in D.C. underground cable networks without cutting the cables or otherwise disturbing the normal operating conditions?
2. Measure current in consumer's service without in any way interfering with the continuity of service?
3. Measure unbalanced current in concentric feeders?
4. Locate unbalanced current on mains and services?
5. Measure electrolysis current flowing over the sheaths of dead D.C. cables or live A.C. three phase three conductor, or two phase four conductor cables?
6. Check station feeder ammeters?
7. Locate defects in underground cables?

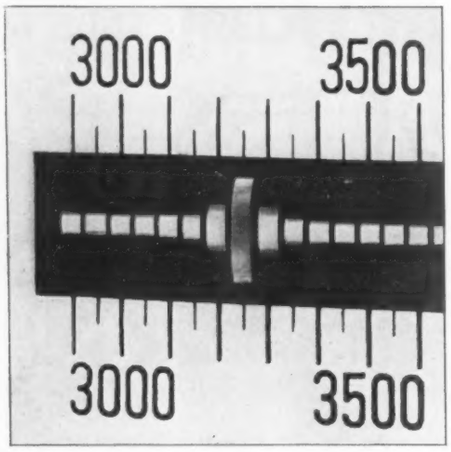
THEN YOU SHOULD NOT BE WITHOUT ONE OF THESE INSTRUMENTS.

LET US SEND YOU ONE OF THESE INSTRUMENTS ON 30 DAYS' APPROVAL FOR TRIAL.

Metropolitan Engineering Co.
42nd Street Building, New York

Canadian Representative — Metropolitan Engineering Co., Ltd., 90 Sherbourne St., Toronto, Canada.

Protection First.



Section of Frahm Tachometer Scale Indicating 3250 R.P.M.

A Speed-Indicator for Permanent Mounting, That Requires No Belt Gears or Electrical Connection.

This is one of the TWO UNIQUE AND EXCLUSIVE FEATURES of our

Frahm Vibration Tachometers

It is only necessary to screw the instrument (on a special bracket which we supply, if desired) to the base or other suitable part of a Steam Turbine, High-Speed Pump, Generator, Motor, etc., and that is "all there is to it!"

And the second *"feature"* is the *principle* upon which Frahm Tachometers operate; namely, a set of steel reeds (like a series of tuning-forks) tuned in resonance with vibrations represented by the speed of the machine to which the instrument is fastened.

There are no springs or other delicate internal parts, and the high initial accuracy is sustained during long periods of continuous duty.

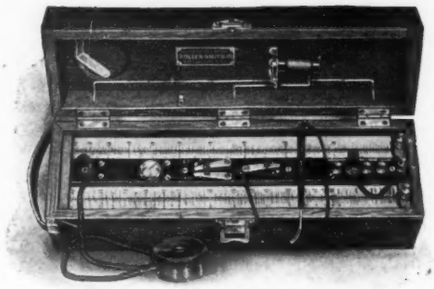
May we send you a copy of illustrated Bulletin 775, which tells about Frahm Tachometers?

JAMES G. BIDDLE
1211-13 Arch Street, Philadelphia
New York Office: 90 West St., Room 1020

For Measuring Resistance
Quickly and Accurately
Use the

ROLLER SMITH

Portable Ohmmeter



A most convenient instrument for all ordinary resistance measurements and extremely simple to operate. Close readings are obtainable, there being 4 ranges, each on a scale 30 inches long. High range 200,000 or 2,000,000 ohms, according to style selected.

An unknown resistance is measured by connecting it to points XX. The plug is inserted in one of the sockets marked "brown, blue, red, black" and the toucher tapped along the wire that runs from end to end of the scale. At a certain point there will be no sound in the telephone (or no deflection in the galvanometer). The resistance is then read off the scale, using figures of color corresponding to the socket. If the first test indicates that a closer reading could be obtained with another range, it is only necessary to change the plug to another socket and find point of silence as before.

There are no loose parts, except two additional scales to lay over regular scales in testing for grounds and crosses. Batteries are supplied in compartment in bottom and are readily renewable. In order to prevent waste of batteries a key is provided, conveniently located in the telephone receiver.

Telephone Type has the telephone receiver only as a means of finding the point of balance. This type is often preferred for its simplicity. It is like cut if the lever switches, galvanometer dial and coil in cover were omitted.

Galvanometer Type. Galvanometer is useful where noise makes telephone readings difficult. It is also more sensitive than the telephone. The induction coil is for the purpose of converting instrument into a Kohlrausch Bridge for measuring resistance of electrolytes, and comparison of inductances and capacities. In addition, this type has all features of telephone type.

Send for Bulletin No. 92

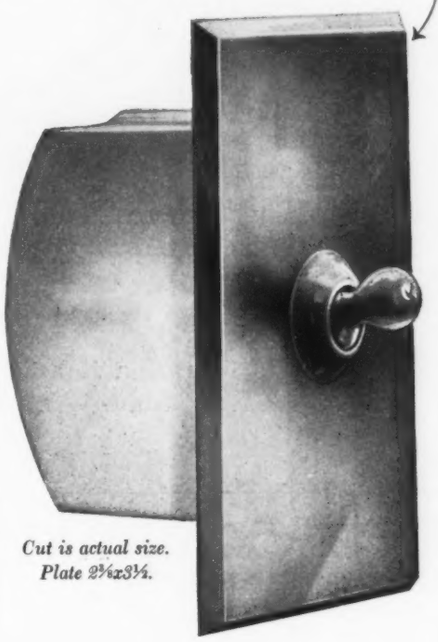
Roller-Smith Company
203 Broadway, New York

CHICAGO Monadnock Block — **Factory** BETHLEHEM, PA. — **CLEVELAND** Williamson Building

BALTIMORE.....Equitable Bldg.
BOSTON.....77 Franklin St.
DETROIT.....Majestic Bldg.
MINNEAPOLIS.....1st Nat.-Soo Line Bldg.
NEW ORLEANS.....Hennen Bldg.
SEATTLE.....Henry Bldg.

Announcing

No screw holes in face plate



Cut is actual size. Plate 2¾x3¼.

The New

Toggle Switch

This type of switch is new in America but old in England and continental Europe.

For the first time made in this country (in improved mechanical form) and

included in the list of Electrical Fittings, published by the Underwriters' Laboratories

A switch of high quality and artistic appearance, the small plate and toggle being of the same finish.

Prices and Discounts on Request.

NEWTON MFG. CO.
LYNBROOK, N. Y.

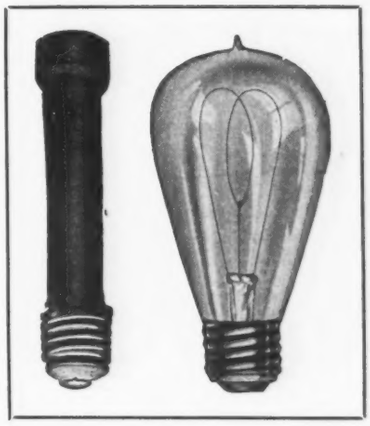
WARD LEONARD RESISTANCES

Each Ward Leonard resistance unit is composed of a porcelain tube, wound with a special resistance wire and covered with a vitreous enamel.

Vitreous enamel assures that the resistance wire will not be affected by chemical, electrical or mechanical depreciation.

RESISTANCES

Replace lamps as resistances



Use Edison Base Resistance Units

90,000 ohms
8⅛" long x 1⅛" in diameter

15,000 ohms
4" long x 7/16" in diameter

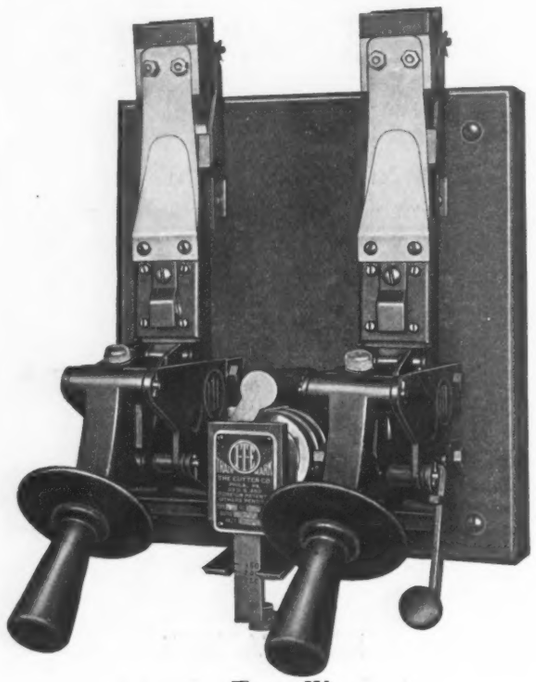
We make resistors of any capacity desired.

Tell us your needs in this line.

Ward Leonard Electric Co., Bronxville, N. Y.
Badt Westburg Electric Co., Chicago, Ill.
John B. Sebring, Pittsburgh, Pa.

2

I-T-E CIRCUIT BREAKERS



Type W

For Direct and Alternating Current
400 Amperes and under

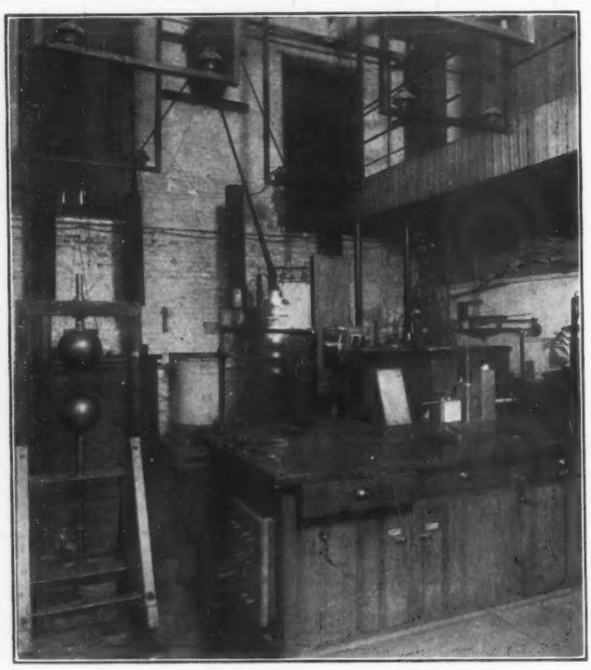
In Use in Thousands of Up-to-Date
Manufacturing Establishments
for the Protection of Motors
and Lighting Circuits

Used in Lieu of Two Fuses and a
Knife Switch; It Saves Money,
Time and Trouble

THE CUTTER COMPANY
PHILADELPHIA

New York, 50 Church St. Chicago, Monadnock Block.
Toronto, Traders Bank Bldg. Pittsburgh, Park Bldg.
Detroit, Mich., Ford Bldg. Minneapolis, Metropolitan Life Bldg.
Indianapolis, Ind., Telephone Bldg.
ECCLES & SMITH COMPANY
Los Angeles San Francisco Portland, Ore.

High Tension Testing



The equipment in this department of E. T. L. work is used for tests extending from the insulating properties of single pieces of paper to insulators carrying the highest voltages available for present day work.

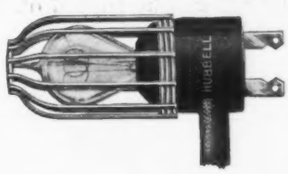
The equipment includes a 10-k.v.a., 100,000-volt transformer, a 50-k.v.a., 275,000 volt transformer, together with auxiliary apparatus.

The cut here shows a high tension suspension insulator spring under test.

Electrical Testing Laboratories, Inc.
80th Street and East End Ave., New York City

A Grave Matter

That's what it is when the user of an electrically heated device forgets to remember that current is on and leaves it to its own destruction. If the unit burns out and the device is ruined, the money it cost is buried beyond resurrection. The Hubbell Signalite never forgets to warn the user not to leave the device with current on. It is a



combination of Hubbell Attachment Plug and miniature lamp base with a small guard to protect the lamp. It fits all Hubbell Receptacles and Hubbell Plug No. 5406. The Signalite should be on every electrically heated device you sell. It is a life saver for devices, a money saver for users, a money maker for dealers.

The Hubbell Signalite Lap

HARVEY HUBBELL, Inc.
Bridgeport, Conn.

HUBBELL

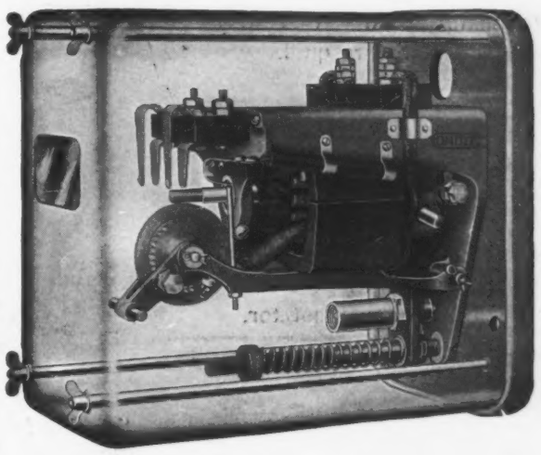
Number 20 of Little Journeys to

CONDIT

Furthermore:

The Type A Relay

has a guaranteed accuracy of 1/20 of a second; it has independent time and current adjustments and it cannot possibly creep. More information in Bulletin No. 407. Let us send you a copy for Xmas.



Condit Electrical Mfg. Co.
Manufacturers of
Electrical Protective Devices
Boston, Mass., U. S. A.

New York, 39 Cortlandt St.
Philadelphia, 1011 Chestnut St.
Pittsburgh, 422 First Ave.
Akron, Flat Iron Bldg.
Seattle, 617 Fourth Ave.
San Francisco, 579-81 Howard St.
Los Angeles, San Fernando Bldg.
Portland, Ore., Morgan Bldg.
Chicago, 19 South Fifth Ave.
Cincinnati, 816 Mercantile Library Bldg.
Denver, 1621 17th Street.
Birmingham, Brown-Marx Bldg.

20
EW

Northern Electric Company
LIMITED

Sole Distributor for the Dominion of Canada, Montreal, Halifax, Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver, Victoria.

Condit Electrical Mfg. Co.

Please send Bulletin 407

Name.....

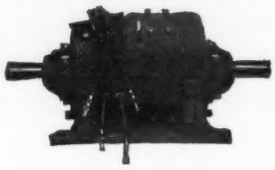
Address.....

City..... State.....

This Trade Mark The Guarantee of Excellence on Goods Electrical.

CO 1800 Crane and Hoist Motor

For Intermittent Service



Hoist service is severe on a motor. Large overloads are sudden and frequent. The relative inaccessibility of the motor minimizes the attention it will receive.

Top half of frame can be lifted off without disturbing back gearing.

Commutator can be readily slipped off armature quill.

Large handhole and bearing covers permit quick and certain inspection.

Shaft can be easily removed from armature without disturbing windings or commutator.

Bearings can be slipped off ends of shaft.

Suitable for floor, wall or ceiling mounting. End shields, feet and shaft extensions same on both ends. Long feet permit wide variation in anchor bolt spacing.

These simple, durable, get-at-able motors have been designed for crane, hoist and other intermittent service requiring a maximum torque motor, of ample overload capacity. Electric brakes of half or full torque capacity can be supplied to assure a quick, sure stop.

Send for bulletin 48100, which describes these motors.

General Electric Company

General Office: **Schenectady, N. Y.**

Sales Offices in All Large Cities

5399

This Trade Mark The Guarantee of Excellence on Goods Electrical.

This Trade Mark The Guarantee of Excellence on Goods Electrical.

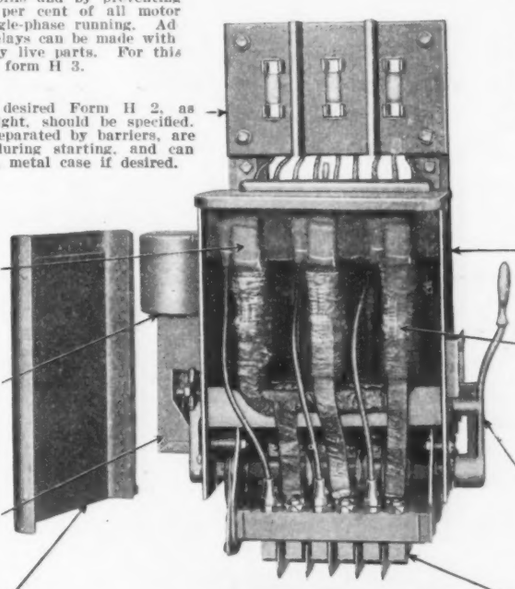
The CR 1034 Compensator

For Squirrel Cage Induction Motors

Overload Relays afford excellent protection to the motor. Used in place of fuses they soon pay for themselves by eliminating fuse bills and by preventing the cause of 90 per cent of all motor burnouts, i.e., single-phase running. Adjustment of the relays can be made without uncovering any live parts. For this equipment specify form H 3.

A Conduit Wiring Case simplifies the wiring and contributes greatly to the neatness of the installation. For this equipment specify Form H 5.

If fuses are desired Form H 2, as shown at the right, should be specified. The fuses are separated by barriers, are not in circuit during starting, and can be enclosed in a metal case if desired.



Taps are brought out from each coil to give 50, 65 or 80 per cent of line voltage in starting motors 18 horse power and below and 40, 58, 70 or 85 per cent for larger motors.

The Low Voltage Release saves fuses and protects the operator by preventing restarting of the motor after failure of voltage. This release throws the handle to the "Off" position when power fails. Push buttons connected in this circuit will provide **"Emergency Stop."**

All **Parts** of the low voltage release, coils and mechanism, are enclosed preventing mechanical injury.

The Cover is removable for inspection or changing of the tap connections. Complete instructions for installing and operating placed inside the cover.

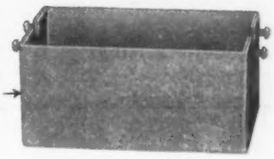
Frames are either pressed steel or cast iron depending on the size. The first four sizes are arranged for mounting on the wall, while all others are for mounting on the floor.

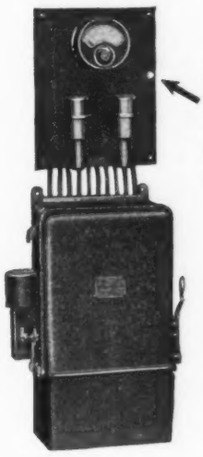
Impregnation of Coils under vacuum makes them moisture-proof, increases insulation, improves radiation, and adds mechanical strength. Coils are rigidly supported in the frame.

The Handle must be thrown all the way to the starting position before it can be thrown to the running position. **A Locking Device** can be supplied so that the handle can be locked in the "Off" position.

The Switch has heavy wiping contacts and all arcing is confined to the tips and takes place under oil. The wiping action keeps them bright and smooth.

The Oil Tank when removed exposes the switch parts for inspection or repairs without disturbing other parts.





The Ammeter mounted on the same panel as the overload relays is an additional insurance against seriously overloading the motor. Specify Form H 4.

Made in all Sizes

From 5 to 250 Horsepower

All standard voltages and frequencies for either two or three phase circuits.

Simplicity of Operation with all live or moving parts enclosed tends toward the elimination of accidents. Specify Form H 13.

For small A. C. motors, investigate the CR 1031 switch, built in the same case as the 1034 but without compensator coils. Ask our nearest office for complete information.

General Electric Company

General Office: **Schenectady, N. Y.**

Sales Offices in All Large Cities

5896

This Trade Mark The Guarantee of Excellence on Goods Electrical.

This Trade Mark The Guarantee of Excellence on Goods Electrical.

Inexpensive Hospital Signal Lighting

THE General Electric Company has developed a simple, inexpensive signal lighting system for use in hospitals. This system is designed for use in connection with standard lighting circuits.

Full information on this system has been prepared in leaflet form and will be sent to anyone interested upon request.

Ask for folder B-9533

Address Supply Department
Schenectady, N. Y.

G-E Reliable Wiring Devices
are sold by distributors in all large cities

General Electric Company
General Office: **Schenectady, N. Y.**

Sales Offices in All Large Cities

5868

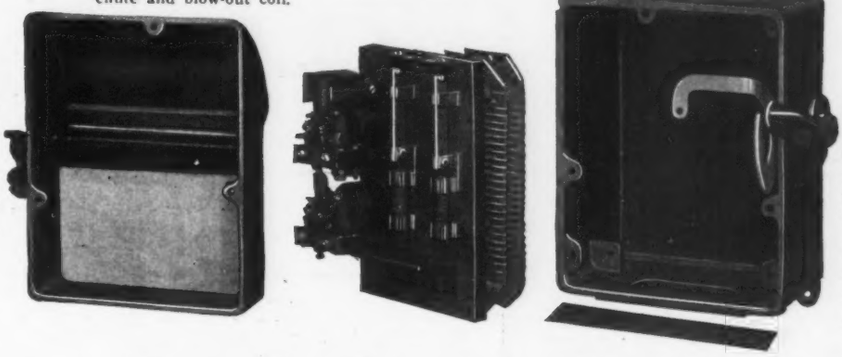
This Trade Mark The Guarantee of Excellence on Goods Electrical.

This Trade Mark The Guarantee of Excellence on Goods Electrical.

The Resistance is wire-wound and baked in a fire-proof insulating compound.
The Line Contactor has a substantial arc chute and blow-out coil.

The Cover is easily removed for inspection or repairs.

A Diagram showing all standard connections is pasted inside the cover.



The Cast Iron Enclosing Case protects the live parts from dust and prevents accidental contact with them.

The Terminal Board is covered by a plate to prevent accidental contact when cover is open.

For Your Small Direct Current Motors

The CR 2271 Self Starter is recommended for machine tool or any other similar constant speed service. It can be used with a field rheostat separately mounted for adjustable speed motors having a speed range not greater than 2 to 1.

Safety Features: Enclosing case and terminal plate protect operator from accidental contact with live parts.

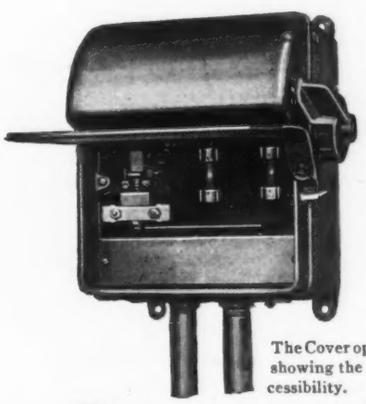
The line switch is operated by a lever outside the case.

Either the cover can be locked shut or the switch locked open.

The cover cannot be lifted when the line switch is closed.

The switch cannot be closed when the cover is open.

Push button control protects the operator and the machine by preventing unexpected starting on return of voltage.



The Cover open showing the accessibility.

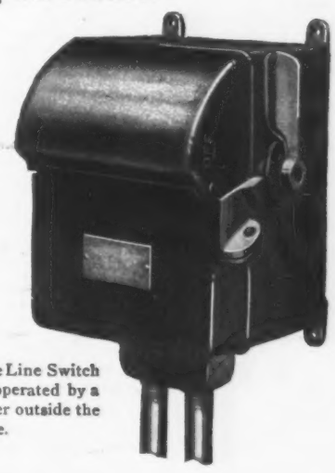
Remote Control can be used with either a "start" and "stop" push button station or a float switch or pressure governor, etc.

Capacity, 1 to 3 H.P., 115 and 230 volts.

Dimensions, 11½ inches high, 9½ inches wide, 8½ inches front to back.

Weight. ready to ship, 50 pounds.

Complete Information from Our Nearest Office



The Line Switch is operated by a lever outside the case.

General Electric Company

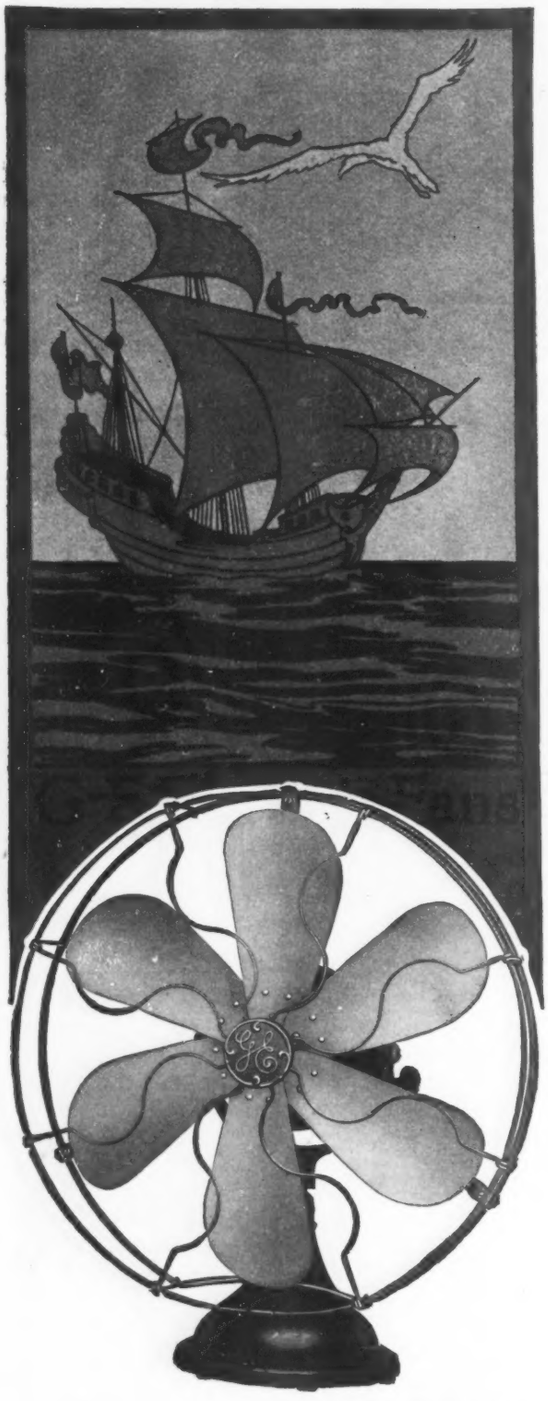
General Office: **Schenectady, N. Y.**

Sales Offices in All Large Cities

5893

This Trade Mark The Guarantee of Excellence on Goods Electrical.

This Trade Mark The Guarantee of Excellence on Goods Electrical.



G-E Fans for 1916

The effect of the nation-wide, "bigger business" will be a greater demand for comforts and necessities in home, office and shop.

1916 will be a big G-E Fan year—let us help you make it the biggest in history.

Our advertising plans for 1916 embody a broader scope, a better service, a greater analysis of your particular needs than ever before.

When making your 1916 G-E Fan Contract—you tie up with over twenty-years leadership in quality, service and reputation. You also know that the line is complete whatever fan you call for. And, further, you have the immeasurable advantage of all the broad-gauged G-E national advertising, sales helps and assistance in putting G-E Fans over the counter.

Write for new Booklet.

General Electric Company

General Office: **Schenectady, N. Y.**

Sales Offices in All Large Cities

5919

This Trade Mark The Guarantee of Excellence on Goods Electrical.

This Trade Mark The Guarantee of Excellence on Goods Electrical.

G-E MAZDA Series Street Lighting

Novalux Units

Pendent

Form 1.

Form 2

Form 6

Ornamental

Form 9-Form 8-Form 4

Auto Transformer

IL Transformer

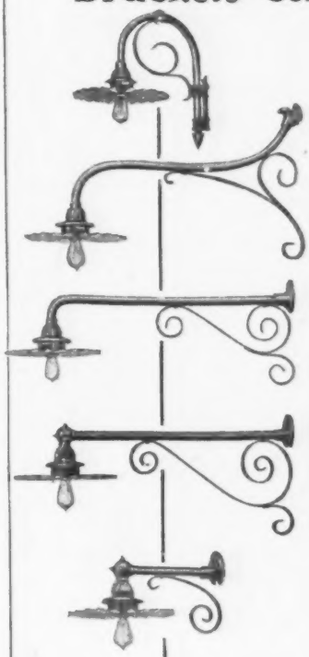
YOU CAN SELECT from the comprehensive G-E MAZDA Series system the correct lighting unit for your Business streets, Residential streets and outlying districts; also the current regulator that will meet your particular conditions.

The G-E MAZDA Series System is founded on broad experience with modern street illumination requirements and is backed by the reputation of a Company that makes everything from generator to lamp.

Only one unit of each line is shown here; write for complete information.

Fixtures

Brackets

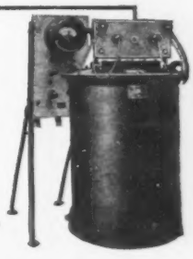


Center Span

SL Transformer

CC Transformer

PD Transformer


SA Regulator

General Electric Company

General Office: Sales Offices in All Large Cities **Schenectady, N. Y.**

5695

This Trade Mark The Guarantee of Excellence on Goods Electrical.

A Significant Fact
Of the three Cables in the Trans-Isthmian Duct Line one is a paper-lead telephone cable—the other two are
KERITE
(taped and braided)—the Panama Railroad's signal cable and the Central and South American Telegraph Company's connection between its Atlantic and Pacific cables.
The severity of the conditions and the importance of the service determined the selection of Kerite for these installations.
KERITE INSULATED WIRE & CABLE COMPANY
NEW YORK CHICAGO

PARANITE
RUBBER COVERED
WIRES & CABLES
If it's PARANITE it's right
More than meets code requirements
Underground, Aerial, Submarine and Inside Use, Telephone, Telegraph, Fire Alarm, Electric Light and Power Wires and Cables.
THE BEST FOR EVERY PURPOSE
INDIANA RUBBER & INSULATED WIRE CO.
JONESBORO, IND.
CHICAGO BRANCH:
210 S. DESPLAINES ST
EASTERN REPRESENTATIVES:
THOMAS & BETTS CO 105 HUDSON ST., N.Y.

THE STANDARD FOR RUBBER INSULATION
OKONITE
TRADE MARK REG. U.S. PATENT OFFICE
OKONITE
Quality
is definite—dependable, and has taught users to expect and exact a high standard of service performance.
OKONITE Insulated Wires and Cables are made in but one grade—the BEST.
THE OKONITE CO.
253 Broadway
New York
11

SIMPLEX
STEEL TAPED CABLES

BEST
because
TWO STEEL TAPES
are wound on spirally in
OPPOSITE DIRECTIONS

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
201 DEVONSHIRE ST. BOSTON
CHICAGO SAN FRANCISCO
1919

Some Misconceptions Regarding Advertising in the Electrical Industry

THE ramifications of the electrical industry are so numerous, its activities extend in so many directions and overlap into so many fields, that it is not surprising to find a confused condition of mind among many manufacturers regarding the development of demand for electrical apparatus or material which they have to sell.

While electricity is one of Nature's raw materials and exists in the very air we breathe, as a commercial proposition it must be manufactured, stored and delivered, just as shoes or dry goods are manufactured, stored and delivered.

An Important Distinction

SHOES or dry goods, however, are sold as finished products as they stand, while electricity can only be sold for use in connection with something else.

To illustrate: The average man buys electricity for lighting his home, his store or his office, but the electricity is of no use to him unless he has lamps, wires, sockets, insulation, switches and other controlling and transmission apparatus.

A great factory buys electricity, or makes it, for running its machines, but the electricity is serviceable only in connection with motors.

A man or woman can go into a store, buy a pair of shoes, a gown or a suit, and immediately put these in service without further consideration.

They can also go into a store and buy an electric fan, an electric lamp, an electric hair dryer, an electric motor or similar device, but they cannot use it until it is properly connected with electric energy, of which as a rule they know little or nothing, and a supply of which they must arrange to secure.

It is manifest then, that the selling and advertising problem of the shoe manufacturer, for instance, is comparatively simple compared with the problem of selling which confronts the manufacturer of electrical apparatus or material.

In the shoe business, the distributer of the product, who is the retail dealer, is largely, and in most cases solely, simply a link in the distribution of shoes from the manufacturer to the consumer; while in the electrical industry the distributer of the product, which may be a retail dealer, a contractor, or a Central Station, is not only a distributer of the product but also renders a service in connecting or installing the product, is also a consumer of apparatus and materials by which only it is possible for the final consumer to utilize the product bought, and in the case of the Central Station or factory operating an electrical plant is likewise a manufacturer of electricity.

Distributer Also a Manufacturer

IN addition to that, the distributer in the electrical industry who is not only distributer but likewise a consumer and manufacturer, frequently confronts abstruse technical construction or engineering problems, for which expert service is required, and consequently the consulting engineer becomes a factor in the situation.

It is easy to see, then, that the electrical field is one of interweaving, overlapping lines of activity and endeavor, reaching into every channel and department of community life and of industrial activity.

If electric lamps, light fixtures, motors, meters, wires and all the innumerable materials and products in the electrical business were bought and sold in the same simple way that shoes are bought and sold, there would be no place for an institutional journal such as the Electrical World, or for Electrical World Service.

At most, such a journal would be merely a trade paper.

And it is only by such an analysis as the foregoing that the tremendous reach and range and value of Electrical World Service to both its readers and its advertisers may be appreciated.

Comparatively few persons appreciate the enormous field which Electrical World Service covers, and consequently many manufacturers have false ideas and gain misconceptions regarding the value of addressing their audience through Electrical World Service.

An Overlapping Field

IT is precisely because of this interweaving and overlapping of interests and activities that Electrical World Service maintains its peculiar institutional character. It is precisely for these reasons that Electrical World Service is equally valuable to the manufacturer of electricity whether Central Station or isolated plant, to the consulting engineer or the resident engineer, to the manufacturer of apparatus used by the consumer, to the manufacturer of apparatus used by the manufacturer of electricity, to the dealer who sells electrical apparatus, and to the student of abstruse technical, electrical engineering problems.

Not long ago a manufacturer invented and put on the market a new lighting fixture embodying new principles.

His idea of promoting the sale was, substantially, that as such lighting fixtures are used only in buildings, and as architects are the leading factors in the erection of buildings, and specify the things which go into buildings, his plan of procedure would be to acquaint the architect with the value and merit of his fixture and his problem of selling would be solved.

We were able to promptly convince this manufacturer by definite evidence that while the architect is a prime factor in the design, erection and construction of buildings, when it comes to the problem of electric lighting of these buildings, the architect employs in one way or another the expert counsel and advice of men in the electrical industry who make a study of illuminating problems and that it is the recommendation of these men which usually controls the situation.

The result was that this manufacturer availed himself of Electrical World Service in his advertising campaigns with excellent profit and satisfaction to him, and he is today a regular advertiser in Electrical World.

It is for this reason that manufacturers of all kinds of electrical apparatus and materials find Electrical World Service so profitable, efficient and economical in helping to promote the sale of their products.

A Far-reaching Service

THEY find that through Electrical World Service they reach and educate the consumer of some kinds of things, the seller of other kinds of things, the specifier of all sorts of apparatus and materials.

They find that they reach the resident engineer, the consulting engineer, the contractor, the dealer, the jobber, the electrical engineers of railways, the electrical engineers of mines, factories and institutions generally, and the officials who dominate the buying power of the great Central Station industry.

There are other mediums and means of reaching persons who have a share in the buying power of electrical apparatus, but the greatest single dominating factor in a sales campaign for any kind of electrical apparatus or materials, a factor which exerts power through all the ramifications of the industry, is Electrical World Service.

*Copyright 1915
McGraw Publishing Co., Inc.
239 West 39th Street
New York

Electrical World Service

Member Audit Bureau of Circulations

This is a reprint of Number 6 of a series of twelve booklets on advertising and business promotion. These booklets, as published, will be sent to any address on request.

—the top rating of Wire

Means—A Code rubber covered wire that the Code does not come anywhere near pinching.

Means—A wire second to no other wire (you will hear more about this).

Means—A wire with a factor of safety in insulation that proves good business to buy.

Means—A wire which costs the buyer no more, for the extra service put into it, than ordinary Code wire.

Means—A wire you can handle with profit.

Write for sample and prices.

A A Wire Co., Inc., Newark, N. J.

Electrical Products Co.
253 Broadway, New York, N. Y.

Geo. T. Westcott & Co.
13 N. Jefferson St., Chicago, Ill.

B. B. Shedd
93 Federal St., Boston, Mass.

BELDEN WIRE

MAGNET WIRE
Cotton, Silk, Beldenamel, Cotenamel, Silkenamel, Rectangular and Square.

WINDINGS
Coils, Solenoids, Electro-Magnets

CABLES
Moving Picture Machine, Annunciator and Elevator

Bare and Tinned Copper, Spring-brass, Office Annunciator, Armature, Banding, Norway Iron, Core, Gas Fixture, Telephone, Switchboard, Jumper and Motor Lead

BAKELITE
Moulded Parts, Sheets, Rods and Tubing

CORDS AND CORDAGE
Stranded Tinsel Conductor, Stranded Copper Conductor, Telephone Receiver Transmitter, Switchboard and Push Button

Rubber Insulated Products

FLEXIBLE CORDS
Lamp, Portable, Brewery and Packinghouse

WIRES
Power Lighting Fixture

CABLES
Automobile Lighting and Starting, Elevator Lighting and Control, Theatre, Annunciator and Telephone

Other Products

Winding Machines
Revolution Counters
Tips and Terminals
Battery Connectors
Flexible Copper Connectors
Pigtails
Flexible Metal Conduit
Braided Cotton Sleeving
Electrical Tapes and Webbings
Rubber Friction Tape
Self-Fluxing Solder
Wire Tension Devices
Sterling Varnishes
Wire Test Clamps

For complete list of Belden Products see General Catalog

BELDEN MANUFACTURING COMPANY
2301 Southwestern Ave., Chicago, U. S. A.

C-1

"Nichrome" Heated Electric Grills for Savory Flavory Snacks

Nichrome is the standardized resistor for Quality Heating Sources

Driver-Harris Wire Co.
HARRISON, (Newark) N. J.

Branches
Chicago, Manchester, England

(1)

The American Brass Co.

BENEDICT & BURNHAM BRANCH
Successors to
THE HOLMES, BOOTH & HAYDENS CO.
WATERBURY, CONN.

SUPERIOR WEATHER PROOF "K.K." TRADE MARK ELECTRIC WIRES

Manufacturers of
"K.K." Weatherproof Wire and Cable
Bare Copper Wire and Cable
Slow Burning Weatherproof Office Annunciator and Magnet Wire

NEW YORK OFFICE
99 John Street

The Highest Attainment of Insulation Permanence

AWARDED PANAMA PACIFIC GRAND PRIZE INTERNATIONAL EXPOSITION

Made by
American Steel & Wire Company

Chicago New York Cleveland Pittsburgh Worcester Denver

Export Representative: U. S. Steel Products Co., New York
Pacific Coast Representative: U. S. Steel Products Co.
San Francisco Los Angeles Portland Seattle

RESISTANCE WIRES AND RIBBONS
CALIDO

Highest Quality Resistor for Electrically-Heated Appliances
Ideal "Spark Point Nickel" Pure Nickel
Phenix Alloy 67 German Silver

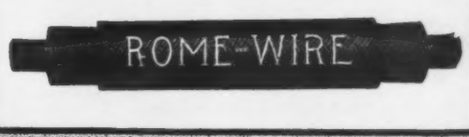
ELECTRICAL ALLOY CO., Morristown, N. J.
NEW YORK, 41 Union Square CHICAGO, 212 W. Austin Ave.

Baker Standard Quality
Platinum
Wire, Sheet, Rivet and Contacts

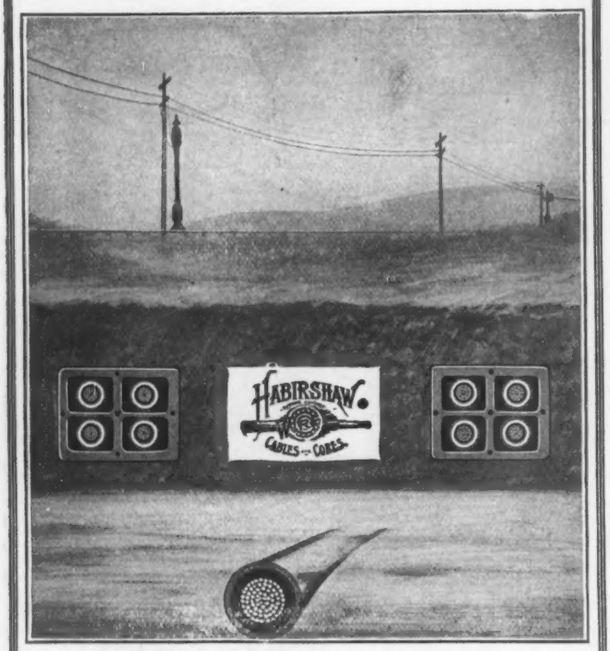
We purchase and exchange
Platinum Scrap

BAKER & CO., Inc.
Murray & Austin Streets
Newark, N. J.
New York Office
30 Church St.

ROME WIRE CO.
ROME, N. Y.



ROUND, SQUARE, FLAT MAGNET WIRE
COTTON, SILK, ENAMEL INSULATIONS

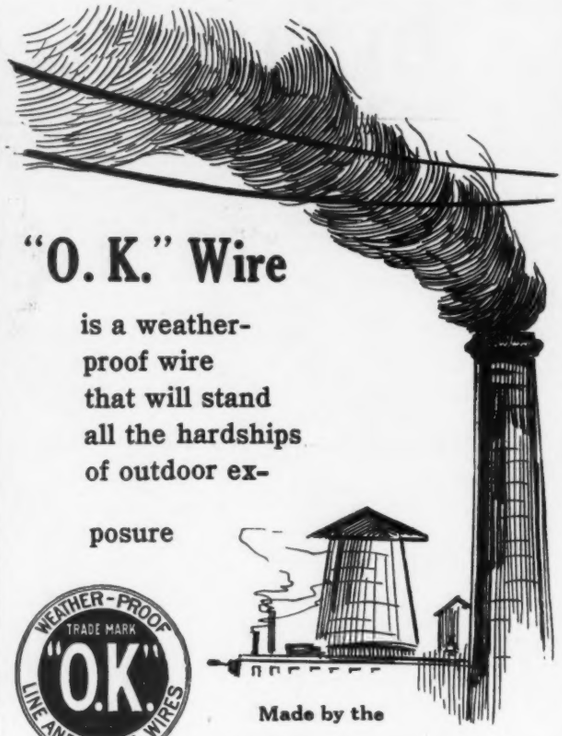


Habirshaw Wires and Cables

For Aerial, Underground, Submarine, Mine, Building and Torpedo Purposes

Habirshaw Wire Company

Office and Works: Yonkers, N. Y.



"O. K." Wire

is a weather-proof wire that will stand all the hardships of outdoor exposure

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

Made by the

Phillips Insulated Wire Co.

Pawtucket, R. I.

3

DOLPHIN

INSULATED WIRE

Notable for its uniformly high quality and dependability.

DOLPHIN ATLANTIC

ATLANTIC INSULATED WIRE & CABLE COMPANY

Sales Office:
120 Liberty Street, New York
Factory: Stamford, Ct.

Commercial Code

Silk and Cotton Covered Lamp and Show Window Cord

WIRES And Cords

Cables for Automobile Lighting Systems

Lowell Insulated Wire Company

Lowell, Mass.

1

TRADE M MARK

Look for the Diamond M

Magnet Wire

We carry a complete stock of cotton, silk and enamel magnet wire in our various warehouses throughout the country.

ALFRED F. MOORE

200 N. Third St., Philadelphia

NEW YORK CLEVELAND CHICAGO BOSTON
CHATTANOOGA NEW ORLEANS

SEAMLESS RUBBER SAFETY INSULATIONS

SAFETY INSULATED WIRE & CABLE CO.

114 Liberty Street. NEW YORK

CHICAGO SAN FRANCISCO BOSTON

76 Years of Manufacture

INSULATED WIRE AND CABLES

JOHN A. ROEBLING'S SONS CO., Trenton, N. J.

Two Seconds'—Time Exposure—with Flash

Belt Running 31½ Feet per Second

Photo Has Not Been Retouched

Compare this drive with your own belt drives.

The photograph was taken in our own shops. It shows the perfect action of belts when run on

Rockwood Paper Pulleys

If you could cut your present slip losses in half and double the life of your belts would you consider the difference worth while? Rockwood Paper Pulleys would do it for you—and more

They Are the Perfect Pulleys for Belt Drives

You are safe in buying them today—Twenty-five years of continued satisfactory service has proven their worth.

They Have Stood the Test of Time

Specify a Rockwood Paper Pulley for your next motor or generator—All electrical manufacturers supply them.

The Rockwood Manufacturing Company

Indianapolis, Indiana, U. S. A.

HESS-BRIGHT

HB DWF

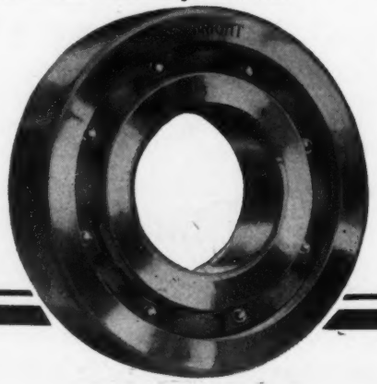
The Inimitable Bearing

used on Ridgway-Rateau Turbines

Two Hess-Bright Ball Bearings take governor thrust on these turbines.

Rightly do the manufacturers of these turbines refer to the Governor as "the simplest and most effective system of steam regulation ever incorporated in a turbine," and rate it as one of the most important features of their new product.

A splendid tribute to the efficiency of Hess-Brights.

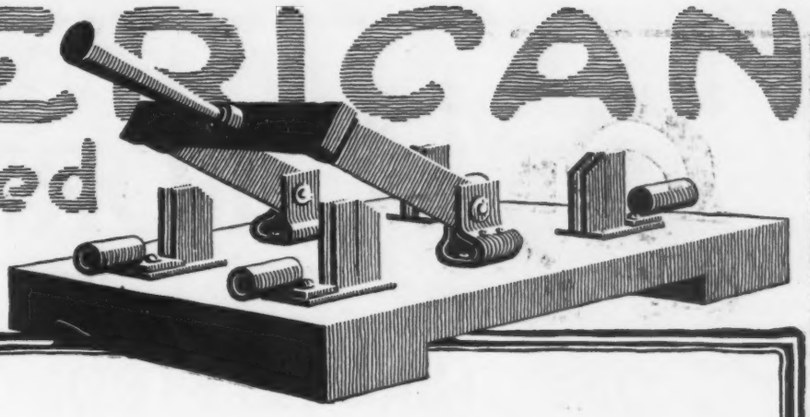


THE HESS-BRIGHT MFG. CO.

FRONT ST. and ERIE AVE.
PHILA., PA.

Hess-Bright's Conrad Patents are thoroughly adjudicated.

AMERICAN Vulcanized Fibre



Machinable Insulation

In this knife-switch, the panel, the cross piece and the handle are American Vulcanized Fibre—completely machined at our Wilmington shops.

There are thousands of other insulating pieces used in the electrical and mechanical industries—armature wedges, cord adjusters, insulating bushings, automobile conduits, machined rings, cleats, gears, and every other item imaginable—that we make by the million.

And the best evidence of the fitness of this insulation is its widespread use, based on a dielectric strength of from 150 to 400 volts per .001" thickness, and physical properties which adapt it admirably to numberless applications in the electrical field.

Prices, full information, and free engineering advice will gladly be given about American Vulcanized Fibre, either ready-machined or in the rough —that is, in sheets, rods, bars or tubes. Write today.

American Vulcanized Fibre Co.

535-555 Equitable Building Wilmington, Delaware

P & B

Insulating Varnishes
Compound
Tape

Send for Booklet, describing tests and methods for best installation.

The Standard Paint Company

100 William Street
New York City

Chicago Denver Boston

1

PERFECT
MICANITE
INSULATION
REGISTERED

And Other Dependable Insulations

Bulletins for the asking

Mica Insulator Company

Manufacturers

68 Church Street
New York

542 So. Dearborn Street
Chicago

Schenectady, N. Y.

When You Need
Moulded Electrical Insulation

Send Blue Prints or Models and ask *us* to quote on *your* requirements.

DICKINSON MFG. CO.
Established 1875 as Dickinson Hard Rubber Co.
SPRINGFIELD MASS
KURT R. STERNBERG. Treasurer and General Manager

ELECTRICAL SHEETS

Highest quality for Dynamos, Transformers, Motors, Etc.—APOLLO SPECIAL ELECTRICAL, Dynamo Special, Am. Armature, U. S. Electrical, Pole Face, Etc.
AMERICAN SHEET AND TIN PLATE COMPANY, Pittsburgh, Pa.

MONSON SLATE

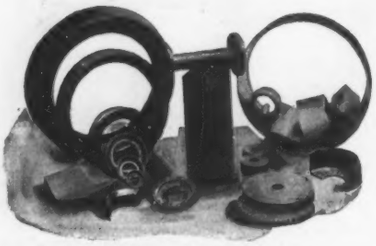
for all ELECTRICAL PURPOSES
Strength, High Quality

PROMPT SHIPMENTS, ALL SIZES
PORTLAND-MONSON SLATE CO., Portland, Me.

ELECTRICAL SLATE

IMPERIAL BLACK MONSON BLACK
PENRHYN PURPLE
Large Stocks Accurate Work

DAVIS SLATE & MFG. CO.
CHICAGO, ILL. BANGOR, PA.



FORMICA

INSULATION

—ONE THIRD AS STRONG AS STEEL

Indispensable where great strength and unusual toughness are required, where limited space requires thin material without danger of breakage, or where severe strains are encountered. It has much greater strength than fibre, but none of fibre's defects. Formica is the one strong insulation.

Formica is also water-repellant, oil-proof, infusible, insoluble and of the highest dielectric strength.

Our folder describes many other desirable properties in detail. Send for it—and samples.

THE FORMICA INSULATION CO., CINCINNATI.

FIELD
COILS
SOLENOIDS
ELECTRO
MAGNETS
MAGNET WIRE

THE ACME
WIRE COMPANY

NEW HAVEN
CONNECTICUT

ALUMINUM

Electrical
Conductors

Ingot Sheet
Wire Rod
Tubing

Aluminum
Company of
America
Pittsburgh, Pa.

Sales Offices
New York, Boston, Chicago, Cleveland, Detroit, Philadelphia, Rochester, N. Y., Kansas City, Washington 1

UNIVERSAL TEST CLIP
INSULATED

Time savers in any electrical work requiring quick temporary connections.

Unexcelled for test sets—meters—ignition cell charging.

Free sample—use company letter-head or state your position.

Actual size

R. S. MUELLER & CO., 424 High Ave., S. E., Cleveland

M-R INSULATION MFG CO

Mitchell-Rand Mfg. Co.

Electrical Insulating Materials
of every description

Office: 99 John St., New York City

CONDENSITE
Molded Insulation

Condensite is not a mere compound or admixture of old substances, but a unique synthetic chemical product.

All the properties essential to good insulation are combined in higher degree in Condensite than in any other substance.

It contains no water either free or combined and will not absorb it. It is a splendid dielectric, showing a strength of 400 volts in a thickness of 150 mils and better. It is very hard and retains its finish. It is not affected by temperatures below the point of carbonization. It is high in mechanical strength, showing per square inch a tensile strength of 5,000 lbs. crushing of 25,600 lbs. cold, 11,070 at 218° F, transverse 3,070 lbs. for a 1½" section between 8" centers. It can be molded with all kinds of metal inserts.

We do not do any molding ourselves, but furnish Condensite in a condition ready to use to the molding trade whose names we will furnish on request.

Condensite technical cements and impregnating enamels are other preparations of this substance of particular interest to the electrical industry.

Descriptive pamphlets on request.

Condensite Company of America
Bloomfield, N. J.

HARD PORCELAIN
For Electrical Specialties
IMPERIAL PORCELAIN WORKS
TRENTON, N. J.

LAVITE Electrical Insulation
Has been used for 40 years by leading electrical manufacturers.
Samples on request
D. M. STEWARD MFG. CO., Chattanooga, Tenn., U. S. A.
3

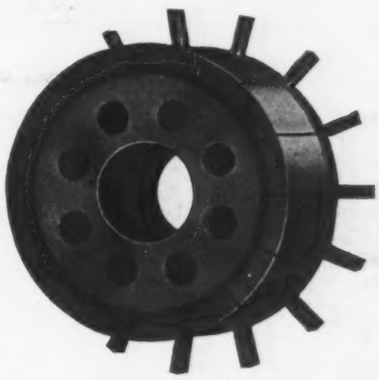
DISFICO
HORN INSULATION
can be pressed into any form and
Will—Not—Crack
IN ROLLS OR SHEETS
For Armature Insulation etc.
DIAMOND STATE FIBRE CO., Elsmere, Del.

THE STANDARD
PORTABLE ELECTRIC DRILLS AND GRINDERS
Operate on any Lamp Socket.
Are Interchangeable on both A. C. and D. C
Write for Bulletins.
Special Proposition to Agents.
The STANDARD ELECTRIC TOOL CO., Cincinnati, Ohio

The Segments Can't Work Loose

Even at extremely high speeds, there's no danger of loose commutators, for the copper segments and combination steel sleeve and reinforcing rings are embedded in

BAKELITE



2¼" diam., 1¾" face

All parts are moulded in at one operation, which gives great strength and reduces cost of manufacture—there's no expense for mica V-rings and no unprofitable motions in slow and expensive assembling. Short circuits eliminated.

19,000 revolutions per minute (the limit of the testing machine) didn't injure this commutator—not in the least.

BAKELITE MOULDED COMMUTATORS are very strong, impervious to moisture, dust and oils, and the insulation will not soften at the highest temperature in which electrical machinery operates. In fact, heat *hardens* **BAKELITE.**

GENERAL BAKELITE COMPANY
100 WILLIAM STREET, NEW YORK

55-125

Collets are Expensive

Loose collets do not assure straight threads—you don't need them if you use

Carpenter's Adjustable Dies

TRADE MARK C

held in Carpenter's Adjustable Stock. See page 68 of the Carpenter Catalog—mailed upon request.

The J. M. Carpenter Tap & Die Co., - Pawtucket, R. I.

FOREIGN REPRESENTATIVES:
Alfred Herbert, Ltd., (Coventry, England), Great Britain.
Schuchardt & Schutte—Berlin, Shanghai, Vienna, Stockholm, Tokio, Budapest, Copenhagen, St. Petersburg.
Alfred H. Schutte—Cologne, Brussels, Liege, Paris, Milan, Bilbao, Barcelona 4

When It Goes Right in and Turns Around and Comes Right Out Again

Machine Screws should be more than transient guests in your assembled goods. No screw can stay too long in an electrical device to wear out its welcome. Screws that go in only to fall out should be kept out of your assembling room. Hubbell Machine Screws never abuse their privileges. When they are favored by being bought, they do their best to please. If Hubbell Machine Screws haven't pleased you, it's because you haven't bought them. Samples will prove their worth. Ask and you'll receive.

Harvey Hubbell, Inc., Bridgeport, Conn.

"NORMA"

BALL
ROLLER
THRUST
COMBINATION

THE NORMA COMPANY OF AMERICA

1790 BROADWAY NEW YORK

INSULATING MACHINERY

BRAIDING, TAPING, WINDING, TWINING, CABLING STRANDING, POLISHING AND MEASURING MACHINES CABLE COVERING BRAIDERS

FINE CASTINGS A SPECIALTY

NEW ENGLAND BUTT CO.

304 PEARL ST., PROVIDENCE, R. I., U. S. A.

WINDING MACHINERY

FOR INSULATING WIRE

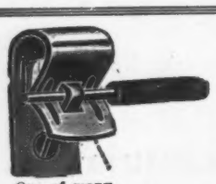
AMERICAN INSULATING MACHINERY CO.

Fairhill and Huntingdon Streets, PHILADELPHIA, PA.

CABLING MACHINERY

AND SPECIAL MACHINERY of any description

The Torrington Mfg. Co.
Torrington, Conn.
U. S. A.



One of many.

FAHNESTOCK

Spring Binding Post

Simply press down on the spring; put in the wire and let go. Efficient, convenient and reliable. We make a number of different sizes and shapes. Send for catalog.

FAHNESTOCK ELECTRIC CO.,
129 Patchen Ave., Brooklyn, N. Y.

The Vulcanized Rubber Company

Manufacturers of

HARD RUBBER GOODS OF EVERY DESCRIPTION

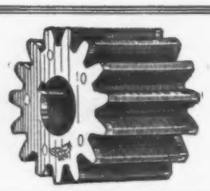
Works MORRISVILLE, PA.

251 Fourth Avenue, NEW YORK

Noiseless Pinions

for motor and other high speed drives, see our large advertisement in first issue of the month.

New Process Gear Corporation
500 Plum St. Syracuse, N. Y.



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The Columbus Die, Tool & Machine Company
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should be very seriously considered before you decide on the duct for your subway system.
Why? See Book E.

THE FIBRE CONDUIT CO.
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FLEXIBLE WOVEN CONDUIT

There is one conduit which has a single wall that cannot be separated or pulled apart
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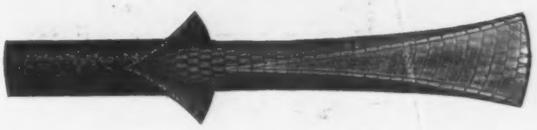
Flexible Conduit



Why consider the destructible when you can have the indestructible?

No matter how badly crushed, twisted or kinked, "Loomflex" can always be pinched back into shape and used. Easy to fish—all sizes are slightly oversized and there are no seams to break loose. The roller-bearing construction of the interior allows the wire to slide through with a minimum of friction.

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Underground Equipment and Tools

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Executive Offices
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Watched and tested throughout all the processes of manufacture. None but the best allowed to go to the consumer. For all purposes and of every description and size. Steel Fishing Snake for Electrical and Conduit Work.
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Transformers, Compensators and Reactance Coils for Tungsten and Nitrogen Lamps

Kuhlman Electric Co.
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20 YEARS' EXPERIENCE Bay City, Mich.

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No matter how long a man may take to decide, when he has signed up a lighting or power contract he wants immediate service. He'll cancel, too, if he doesn't get it. The best way to avoid unpleasant delay and possible loss of contracts is to keep on hand a few

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Then you are equipped to deliver immediately and secure the customer's good will at the outset.

Fifteen years of satisfactory service have fully demonstrated the high efficiency, low core loss, low temperature rise and thorough insulation of Peerless Transformers.

Fully guaranteed for two years against mechanical or electrical defects—even against lightning.

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Manufactured for all electrical purposes in any size, frequency, or voltage.

Lighting and Power Transformers
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Single and 3-Phase Transformers

To secure prices give us K. W. capacity voltage, cycles, transformers required.

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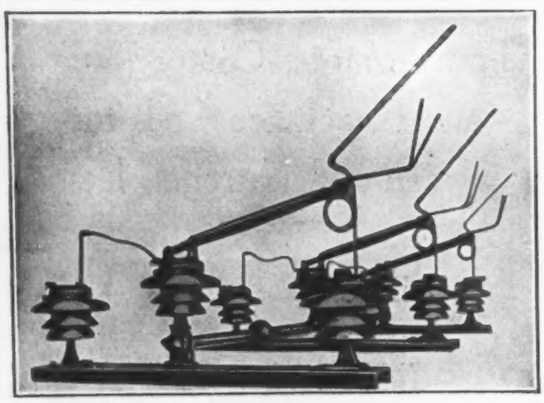
4



THE LOGICAL OUTDOOR SWITCH

for high tension line operation is the

Royal Triple Pole Trolley Switch

It is reliable relief for your troubles due to "burning" contact points and "freezing up" when winter arrives.

Absolute contact by trolley wheel on heavy spring horn. Arcing horns eliminate arcing on trolley. No surfaces on which ice can form in sufficient quantity to hinder operation. Gravity holds the switch shut or open. When open, all equipment is automatically grounded.

The mechanical features are in compliance with the Royal policy—the best in quality and appearance. Furnished any voltage.

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Write for prices and further data.

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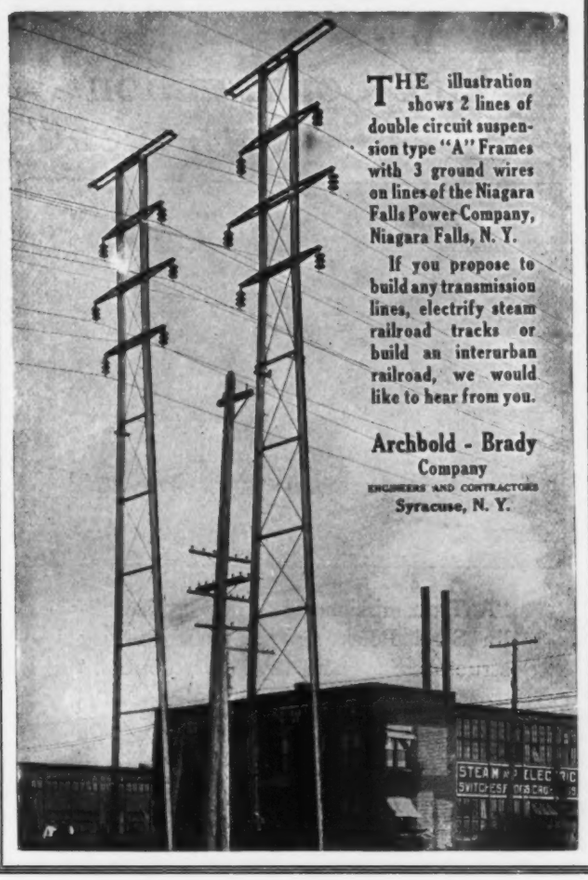

THE illustration shows 2 lines of double circuit suspension type "A" Frames with 3 ground wires on lines of the Niagara Falls Power Company, Niagara Falls, N. Y.

If you propose to build any transmission lines, electrify steam railroad tracks or build an interurban railroad, we would like to hear from you.

Archbold - Brady Company
ENGINEERS AND CONTRACTORS
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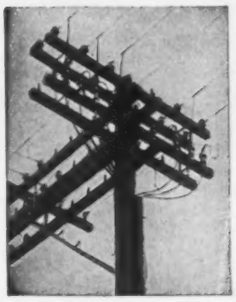
EMERGENCY SERVICE

Can Be Easily Given Quickly with

G & W Detachable Potheads



Open the potheads at the phase center and close those on the emergency tie to the adjacent circuit.

These are full instructions for the simple direct G & W WAY.

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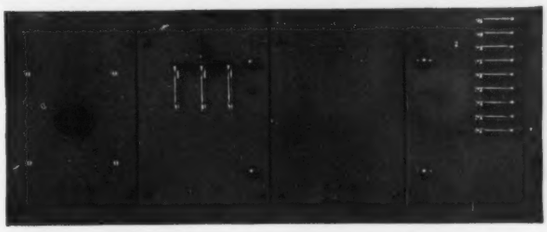

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for D.C. or A.C. testing work, easily adjusted to sectional or unit work.
All connections complete when shipped. No wiring necessary. They offer all the advantages of our regular complete test tables, and will fit all possible conditions—from those of the smallest lighting company to the largest. Send for Circular No. 25.

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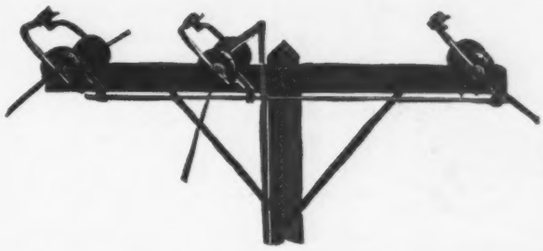

THE K-P-F POLE-TOP SWITCH

withstands the strains of winter blasts and the attacks of ice and snow. When the furious blizzards sweep down upon your transmission lines, then more than ever you need on every pole-top a practical, strong, efficient disconnecting switch for sectionalizing your high voltage lines. The K-P-F makes any pole a self-contained Unit. The same insulators which dead-end your wires hold the switch contacts. The switch may be locked in either open or closed position. Let us send you a copy of Bulletin 102. It tells a money-saving story.

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No Bolts No Rivets

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¼" minimum thickness of metal.

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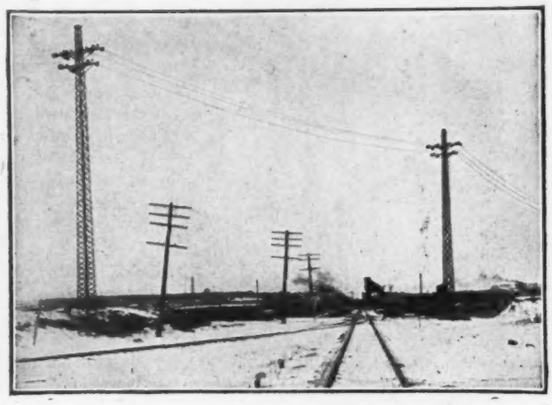
"Make Your Line Construction Permanent"



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STEEL STRUCTURES
OF ALL KINDS

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SUPERIOR DESIGN AND QUALITY FOR EVERY USE
AMERICAN TRANSFORMER COMPANY
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TOOLS

for all classes of electrical construction and repair work. Write for catalog.

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It is "C-A-WOOD-PRESERVER" (Carbolineum-America)—the only Wood Preserver sold with a *quality affidavit* guaranteeing you superiority.

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STEEL TOWER OUTDOOR SUB-STATIONS
DELTA STAR ELECTRIC CO. CHICAGO
ICE PROOF POLE TOP P.M. SWITCHES
ASK FOR TECHNICAL BULLETINS

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Low Temperature—High Temperature

Checkmate them with the

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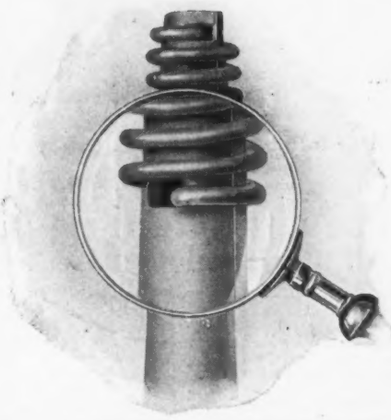
The Peirce Spring Thread has always meant a big decrease in insulator mortality rate.

And the new method of fastening the spring thread makes this doubly sure.

It prevents the locking of insulators too. That's evident.

This is only one of the big features of the new pressed steel Peirce bracket—the big accession to line service.

Put it through bracket-breaking tests. Get your sample now.



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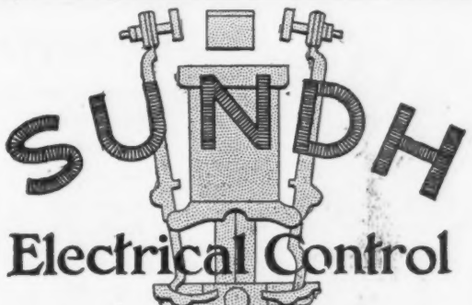

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Electrical Control
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for Central Stations

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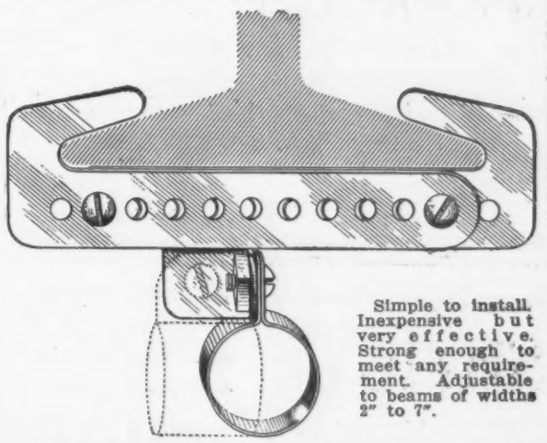
Controlling Devices

Automatic and hand operated Starters and Controllers for all conditions of service.

Industrial Controller Co.
MILWAUKEE

Hanger for Conduit or Open Wiring

A new, handy device designed to facilitate the work of suspending electric lines from steel beams.



Simple to install. Inexpensive but very effective. Strong enough to meet any requirement. Adjustable to beams of widths 2" to 7".

And—it saves money, since its application avoids the expense of boring holes in steel beams—a very costly operation.

As the cut indicates, the clip supports conduit either parallel or at right angles to the beam.

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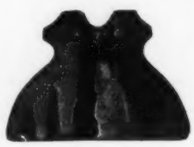
The most successful high voltage insulators ever placed in operation. Install "Pittsburg" porcelain on that new line and make shutdowns a rare occurrence. We make an insulator for every kind of service, wall and roof outlets, floor bushing, line and suspension insulators. Get in touch with our Engineering Dept.



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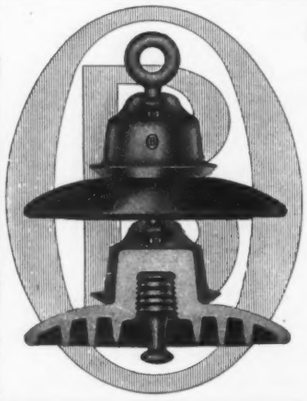

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All Classes of Service
Any Voltage

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Suspension
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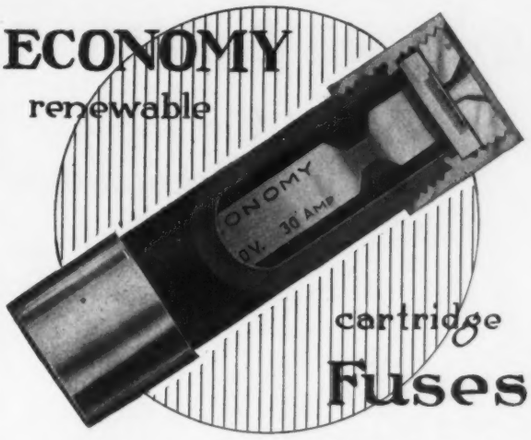

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Products of the most advanced methods of fuse-building.

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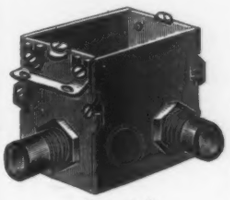
For New Wiring or Re-wiring

one of our most widely used switch boxes, and as widely endorsed, by contractors and electricians, is



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The "GEM" Sectional Switch Box

It is assembled quickly with a screw-driver. The sides are interchangeable. Gangs of any length are readily made from single boxes.

Knockouts are provided in sides, back and ends. Adjustable ears attached for mounting. Nail holes provided in sides also.

It takes all makes of standard push-button switches. Depths vary from 2 in. to 3 in.

The entire line of eight boxes is "approved" and costs no more than the ordinary kind. They are very popular.

Ask your dealer. He carries them.

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"Deltabeston" Magnet Wire

DELTABESTON WIRE

Insulated with asbestos fibre impregnated with a special compound to resist heat. Hot motors need give you no worry after you have specified "Deltabeston" for the windings. Write us.

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Instantload Refill Fuse

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Highest possible standard. Efficient under every test.

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TRADE DAUM MARK **RENEWABLE FUSES**

only require a new fuse element to make them ready for use. Daum fuse strips can be broken off to any amperage with pliers. No shears necessary.
Bulletin J-17 will interest you.

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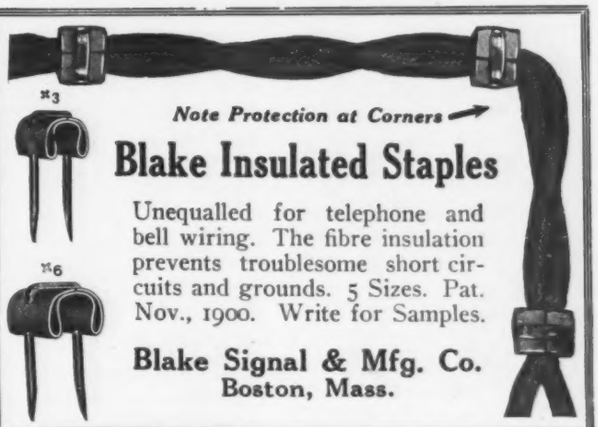

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Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 5 Sizes. Pat. Nov., 1900. Write for Samples.

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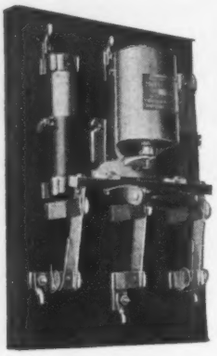

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THERMO-CIRCUIT BREAKER

A hundred dollar reward went with our challenge. To date no one has claimed it.

The Thermo-Circuit Breaker is the logical protection for motors because it watches *motor temperature*—not motor current.

An overload using big current may come down to normal before dangerous heating develops. In that case you want the circuit kept *closed*.

Install the THERMO system to insure *maximum service continuity* with full protection. THERMO TIME FUSES provide the same sort of safeguard.

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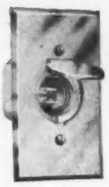

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fit all standard Boxes. Plates all brass, heavy metal.

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All Styles fuseless and fusible—two piece—K. W. and one piece.

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125-250 Volts—N. E. C. Standard

A New Member of the

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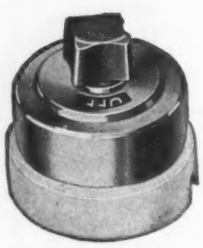

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228 E. Clifton Avenue
CINCINNATI, OHIO 3

You Can Save Current With

Colonial Sign Letters

So designed as to reduce number and candle power of lamps, yet give a bright, sharp sign.

Ask for Booklet and prices

Colonial Sign and Insulator Co., Akron Ohio
2

The Benjamin Attachment Plug

"That Swivel Shell Makes The 9—0—3 Sell"

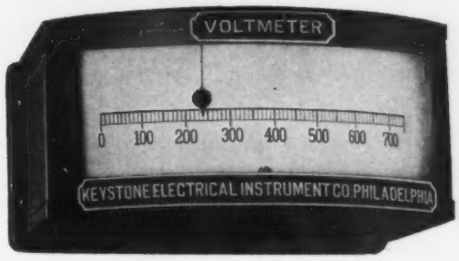
Cat. No. 9—0—3

BENJAMIN ELECTRIC MFG. CO. 1
New York Chicago San Francisco

CRIPPEN & SIDE GUIDE

Keystone

Voltmeters and Ammeters



The horizontal edgewise type of instrument is of much superior instrument design, as the pointer works horizontally. This type also takes up less room on a switchboard. Send for descriptive catalogue.

Keystone Electrical Instrument Co.
Philadelphia, Pa.

New York **Pittsburgh** **Chicago**

4

This Galvanometer

Sensitivity—1 megohm.
Period—2½ seconds.
Resistance—200 ohms.

is useful for a variety of purposes. It is sufficiently sensitive for most commercial Wheatstone Bridge Work. It is rugged enough to be used as a detector galvanometer.

Production in quantity has made it possible for us to sell it at a low price.

Ask for Bulletin No. 232 and for quotation

The Leeds & Northrup Co.
Electrical Measuring Instruments
4903 Stenton Avenue, Philadelphia

BUILT LIKE A WATCH

SANGAMO METERS

For Every Electrical Need
Ask for Bulletins

Sangamo Electric Company
Springfield, Illinois

New York 50 Church St. **Minneapolis** Metropolitan Life Bldg. **Rochester** Mercantile Bldg.
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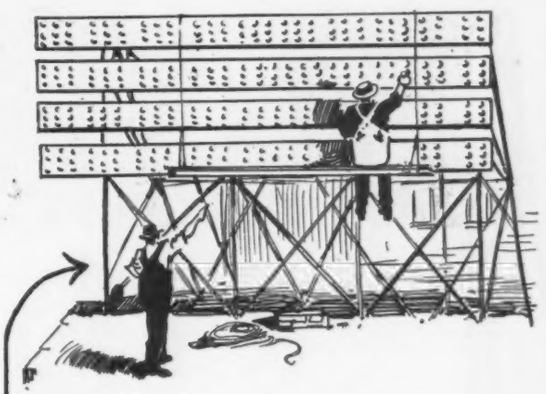
Accurate, Compact, Inexpensive
VOLTMETERS, AMMETERS and VOLT-AMMETERS
Send for complete catalog
LOUIS M. PIGNOLET
78 Cortlandt Street **New York**

GRAPHIC METERS

Portable and Switchboard Types
Ammeters, Voltmeters, Wattmeters, etc.
"The Meter with a Record."

232 E. South Street **The ESTERLINE Co.** Indianapolis, Indiana



To insure completely satisfactory Sign Lighting install the **Campbell Time Switch**

Find out why there are no dissatisfied users.

CAMPBELL ELECTRIC CO.
MAIN OFFICES AND FACTORY: LYNN, MASS.

DUNCAN METERS

At no time in the history of the electric lighting business has such progress been made in developing electric meters as there is right now. With the Duncan Electric Manufacturing Company, this has become a fine art, and no instruments going upon the market today have the same guarantees for accuracy and stability as have the Duncan Model E for D.C. service, and the Model M2 for A.C. service. This same refinement of design and excellence of operation is carried into the Duncan Portable Test instruments, with the result that any plant equipped with Duncan Meters is in the best position possible from both commercial and electrical standpoints.

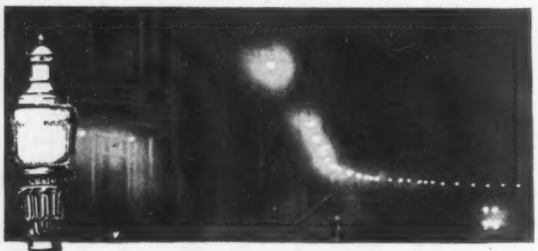
Duncan A.C. and D.C. House Type Meters; Switchboard Meters and Portable Test Meters

DUNCAN TRANSFORMERS

No one will appreciate the sterling qualities and excellent worth of Duncan Transformers as well as those who have been using other makes, and who have been troubled with breakdowns either from lightning or poor construction. Duncan Transformers are now made to withstand every service that may be imposed upon them by the most rigid practice. An entirely new and novel means of impregnating has been developed, which surpasses any other method. It insures an absolute means of having the insulating compound reach every possible pore and interstice within the windings. It cannot be beaten.

"Everybody knows the Duncan products"

DUNCAN ELECTRIC MANUFACTURING COMPANY
LAFAYETTE, INDIANA



From Havana to New York

famous streets are lighted by

Mott Lighting Standards

We can quote interesting figures to central stations who wish to extend their lighting as part of the Electrical Prosperity Week movement.

Address all inquiries to Ornamental Lamp Post Department.

The J. L. Mott Iron Works
Fifth Avenue and 17th Street, New York City 3

The REFLECTOLYTE

The Semi-Indirect Lighting Unit with the Qualities of Opal Glass and the Strength of Steel

WRITE FOR CATALOG

FRANK ADAM ELECTRIC CO., 924 Pine Street **St.Louis, Mo.**

WHITE WAY POLES
MANY DESIGNS AND PRICES RIGHT

WRITE FOR CATALOGUE
KING FOUNDRY COMPANY
ST. JOSEPH, MO.

Best Grade Renewed Lamps
Both Carbon and Tungsten Types
We guarantee you most for the money
BOSTON-ECONOMY LAMP DIVISION
National Lamp Works of General Electric Co.
128 MAPLE ST. DANVERS, MASS.

Lux Nitros
Concentrated Filament, Tungstens
Lux Mfg. Co.
Hoboken, N. J.
Lamps

The DOUBLE Advantage of Industrial ABolites

For Efficient Lighting and Long Lamp Life

When you install ABolites with your Mazda C lamps, you get the advantages of a proper light reflection *and* the full life of the lamp.

The heat generated by the lamp passes rapidly over the socket and out. The design of the ABolite Holder Socket is the next biggest thing to the making of the gas-filled lamp itself.

We believe you ought to learn all the ABolite advantages.

Suppose you write us right now for Bulletin No. 137.

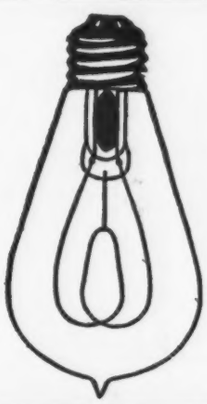
ADAMS-BAGNALL ELECTRIC CO.
CLEVELAND

NEW YORK PITTSBURGH DETROIT CHICAGO ST. LOUIS
Canadian Representative—R.E.T. Pringle—Montreal, Toronto, Winnipeg

Increased Profits

result from Lamp purchases at the

Consolidated Electric Lamp Company
Tapleyville Station,
Danvers, Mass.



7157 2

Hygrade Tungsten Lamps

Sold outright — resold at your own price

HYGRADE INCANDESCENT LAMP CO DANVERS MASS

EXCELLO

Flaming Arc Lamps the most efficient factory light—⅙ watt per C.P.

Kandem Electric Co., Inc., New York
49 East 21st Street

FARIES

New Patented Collar Lock

HALF SHADE

Fits any lamp from 8 C. P. to 60 watt Mazda.

They swivel easily on the socket permitting light to be thrown at any angle.

Easily applied, yet won't come off until you want to take them off.

A quarter turn of the collar locks the shade on.

	Std. Pkg.	List Price
No. 36-A—Steel frosted inside	48	30c
No. 36-B—Br. Br. " "	48	45c
No. 36-C—Ox. Cop. " "	48	50c

FARIES MFG. CO.
DECATUR, ILL.

GRIPPER SIDE GUIDE

No. 158
Bake Oven

SIMPLEX QUALITY

A High, Steady Load which fills in the valleys in the load curve

between 9 A.M. to 4 P.M., and 10 P.M. to 4 A.M.

SIMPLEX ELECTRIC BAKE OVENS

Eliminate underbaking and waste for the Baker
Insure finest products and best working conditions

One Progressive Bakery Proprietor using a Simplex No. 158 Bake oven writes:

"The Electric Oven is very efficient. Before installing this oven we used coal ovens . . . and had three of them . . . two being sufficient for the first four days of the week. This *one Electric Oven* does the work, and we are actually increasing our output. There is a great saving of time and labor, also space. No soot, smoke, ashes, gas or fumes of any kind to contend with, and we get our heat regardless of atmospherical conditions.
"From the point of cleanliness, the Electric Oven is greatly superior to either coal or gas ovens."

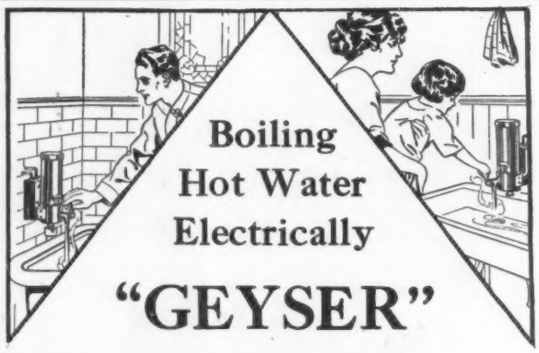
One Month's Production

5400 layers of cake	1000 cookies (dozens)
2000 pies	75 tea biscuits (dozens)
1250 rolls (dozens)	50 loaf cakes
1000 coffee cakes	4500 1-lb. Loaves of bread

The consumption of current on the above production, which is less than capacity, was about 2100 kilowatt hours per week.

Simplex Electric Heating Company

Cambridge, Mass. **Belleville, Ont.**
15 So. Desplaines St., Chicago **612 Howard St., San Francisco**



Boiling Hot Water Electrically

"GEYSER"

Electric Water Heater

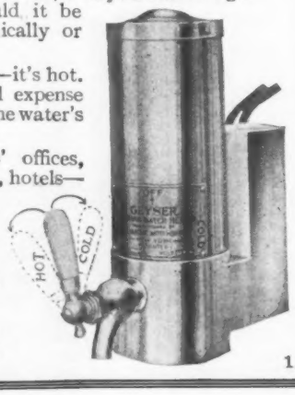
supplies the exact quantity needed—INSTANTLY, at a turn of the faucet.

You *couldn't* get it quicker, and you couldn't get it *hotter*. Neither could it be obtained more economically or safely.

Turn handle to left—it's hot. In neutral position all expense stops. Turn to right—the water's cold.

For homes, doctors' offices, hospitals, barber shops, hotels—no end to "Geyser" applications. Easily attached to any service pipe.

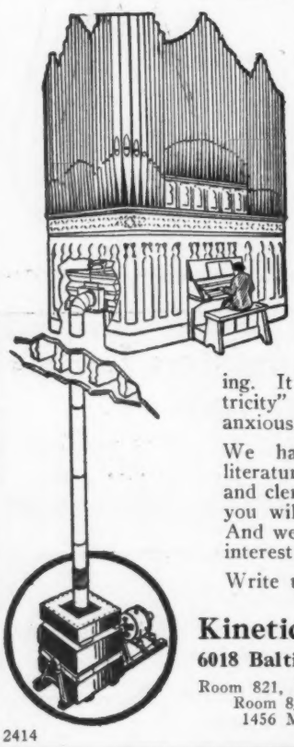
Now galloping to popularity. Write for full information.



Feldman Mfg. Co.
254 West 44th Street, New York City

1

Give Current Use a Boost



Popularize its consumption in the churches by securing the installation of the

Kinetic Electric Blower

It will draw attention to the serviceability of electricity. It will give you a talking point for more wiring. It will further the "electricity" habit you are so anxious about.

We have strong "campaign literature" for the organists and clergymen of your town if you will give us their names. And we have an offer that will interest *You*.

Write us today.

Kinetic Engineering Co.
6018 Baltimore Ave., Philadelphia

Room 821, No. 41 Park Row, New York;
Room 8, No. 12 Pearl St., Boston;
1456 Monadnock Block, Chicago.

2414 1

A New Bulletin on Storage Battery Trucks

We have just prepared a new bulletin on the subject of Storage Battery Industrial Trucks and Tractors. It gives much valuable data as to services for which these trucks are adapted, also illustrates many applications of these trucks.

A copy can be secured from any Office of the Company.

THE ELECTRIC STORAGE BATTERY CO.

New York Boston PHILADELPHIA, PA. Chicago Denver
St. Louis Cleveland Atlanta 1888-1915 Rochester Detroit Toronto
Washington Pittsburg San Francisco Los Angeles Seattle

We Finance
Extensions and Improvements

to Electric Light, Power and Street Railway properties which have established earnings. If prevented from improving or extending your plant because no more bonds can be issued or sold, or for any other reason, correspond with us.

Electric Bond and Share Company

Paid-up Capital and Surplus, $15,000,000

71 Broadway, New York

Dealers in Proven Electric Light, Power and Street Railway Bonds and Stocks.

Storage Batteries
for Vehicles, Train Lighting, Isolated Plants, Ignition, Starting and Lighting

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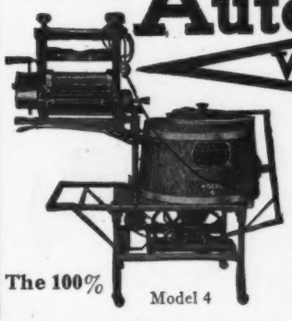
GENERAL LEAD BATTERIES COMPANY
GRAND STREET AND LISTER AVENUE
NEWARK, N.J.

Get Our Proposition

The 100% **AutoMatic Washer**



Is the QUALITY Washer. IT HAS NO EQUAL

This splendid AUTOMATIC Electric Washer, Model 4, has a compact short bench that FOLDS UP when not in use. Has full washing capacity and takes but 2 ft. sq. floor space. Has ALL up-to-date features, including the Reversible-Swinging Wringer. Simple in design; faultless in construction; elegant in finish and perfect in operation, is easy to sell and its users are always satisfied. **SIX MODELS.** Send for Bulletin 77. It's FREE and tells the AUTOMATIC STORY.

The 100% Model 4

Automatic Electric Washer Co., Inc., Newton, Iowa, U.S.A.

Flood Lighting

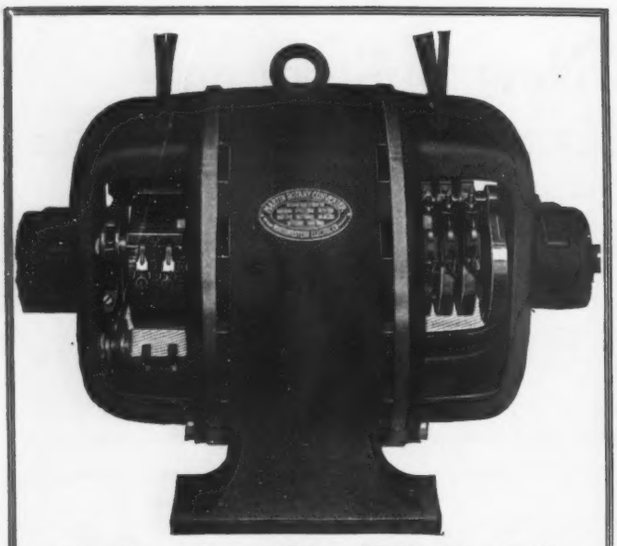
ARMOUR & COMPANY ARE NOW

ICE HARVESTING AT NIGHT

Flooding with four of these lamps a lake 3/4 of a mile long by 1/2 a mile wide.

ELECTRIC AMERICAN LIGHTING COMPANY SUNLIGHT
Manufacturers

621 W. JACKSON BLVD., CHICAGO



MARTIN

Rotary Converter

for charging Storage Batteries under the constant Potential Method

Write for full particulars

Northwestern Electric Co.

611-615 W. Adams St., Chicago, Ill.
New York, 401 Broome Street
Montreal, Quebec, 216 Bishop Street
Toronto, Ontario, 308 Tyrrell Street

We are discovering new fields every day for the KIMBLE adjustable speed alternating current MOTOR

This motor gives flexible speed control with alternating current electricity and holds any speed at which it is set, through all changes of load.

In other words, it marks an important forward step in the sale of alternating current electricity.

Let us show you how we can help you sell both our motor and your current.

KIMBLE MOTORS

KIMBLE ELECTRIC COMPANY
637 N. Western Ave., Chicago, Ill.

Sprague Electric Motors

ARE THE STANDARD

for

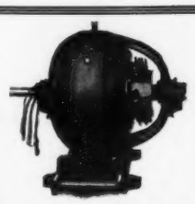
VENTILATING EQUIPMENTS

Direct and Alternating Current.
Built to withstand hard service.
Standard size equipments carried in stock for immediate shipment.

Send for Descriptive Bulletin No. 2463

SPRAGUE ELECTRIC WORKS
OF GENERAL ELECTRIC COMPANY
Main Offices:
527-531 West 34th Street, New York, N. Y.
Branch Offices in Principal Cities

C & C MOTORS



FOR driving line shafting, machinery, hoists and blowers, fans, etc., in places where dust flies freely, constant operation is imperative and skilled mechanical attendance is not readily available, there is no motor that can stand the test like a C & C Type S L Motors are rugged in mechanical and electrical construction, are conservatively rated and designed with radical provision for freedom from heating under abnormal and adverse conditions. C & C Motors assure absolute reliability for constant operation without attendance. They are built in all sizes in open, semi-enclosed and totally enclosed types.

For an efficient, permanent, reliable drive, specify C & C Motors and put your requirements up to our Engineering Department. Write for Bulletin F 101.

RELIABILITY
C&C ELECTRIC & MFG. CO.
GARWOOD, N. J.

Branches in all Principal Cities.
New York Chicago Boston Philadelphia 117

Robbins & Myers Small Motors and "Standard" Fans

The Robbins and Myers Line includes standard motors for all services in sizes ranging from 1/40 to 15 Horse-Power.

They are furnished for all commercial D.C. and A.C. circuits.

"Standard" Fans are made in all types for all services, alternating and direct current.

THE ROBBINS & MYERS COMPANY
SPRINGFIELD, O.
The World's Largest Exclusive Manufacturer of Electric Fans and Small Motors

Can't we get a good motor built especially for us?

"A poor motor is ruining our product", said the Sales Manager. "We've never seemed able to get a motor that is exactly suited to our machine. What we want, what we must have, is a motor that is "fool proof", always reliable, sturdy, compact, light weight,---in short, a motor as good as our product and in every way fitted to it."

That Sales Manager grasped the weakness of many of the present motor driven devices. Of what use are the many attachments and exclusive features you've worked so hard to incorporate into your machine if the motor goes wrong? Remember, people don't blame the motor when it balks---they condemn the whole machine.

We are small motor specialists and our engineers challenge you to put an application up to them that they can't solve. Not only that, but we have the best equipment and organization in the country with which to build both standard and special motors in any quantities.

If you have a machine or especially if you market a product and wish to equip it with the best fractional horse power motor, it will pay you to send for our Bulletin 1146 and learn what we are doing for the majority of the leading manufacturers of industrial and domestic power driven devices.

FORT WAYNE ELECTRIC WORKS

OF GENERAL ELECTRIC COMPANY

"WOOD" SYSTEMS

1609 Broadway FORT WAYNE, IND.

M-46

LINCOLN MOTORS

This extraordinary test insures you against loss of service which often occurs when moisture, oil or solutions get into the coils of the motor.

This 3½ H.P. Lincoln Motor has been operating under water for two years without loss of efficiency.

Lincoln Electric Company

Kelley Ave., and 38th St., Cleveland, Ohio

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Braunlich-Roessle Co.
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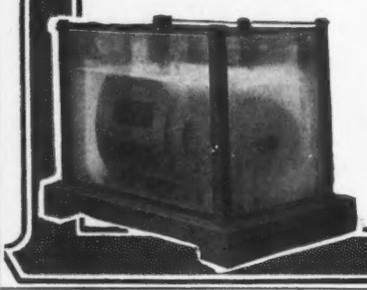
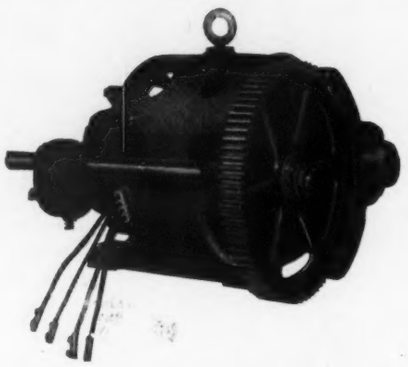


The Counter Shaft Bearings on

Century

SINGLE PHASE BACK-GEARED MOTORS



cannot get out of alignment as the housings are cast integral with the end brackets which are keyed to the motor frame.

The gears are machine cut cast iron and the pinions are of large dimensions.

CENTURY ELECTRIC CO.

19th, Pine to Olive Sts. St. Louis, Mo. **New York Office 30 Church St.**

187

LE CARBONE—

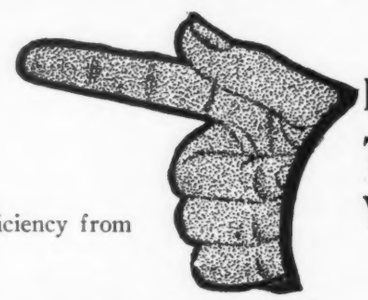
The brush of unvarying quality.

The brush that eliminates commutator wear and trouble.

The brush that gives the longest life.

The brush that enables you to obtain the highest efficiency from your equipment.

NOW is the time to try them.



Here's The Brush You Want

174 FULTON STREET **W. J. JEANDRON** **NEW YORK CITY**

Pittsburgh Office:
634 Wabash Bldg., W. P. Poynton, Engineer

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MANUFACTURERS OF ELECTRICAL MACHINERY
MOTORS
BURKE ELECTRIC
GENERATORS
COMPANY
TRANSFORMERS
ERIE, PA.

MOTORS

For all purposes where reliable power is essential.

ALL SIZES ALL SPEEDS ALL VOLTAGES

Direct and 2 or 3 phase Alternating Current

BURKE ELECTRIC COMPANY

Works: Erie, Pa. **Sales Offices in Principal Cities**

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire.
All of this may be avoided if you use

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting.
Absolutely will not gum the brushes.

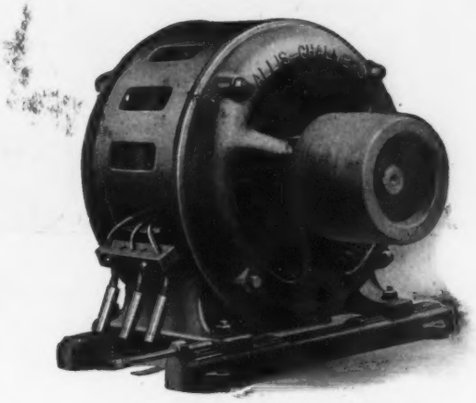
It will put that high gloss on the commutator you have so long sought after

Send for Stick **50c PER STICK** **$5.00 PER DOZ.**

For Sale by all Supply Houses, or **K. McLennan & Co.** Sole Manufacturers

102 N. Fifth Ave., CHICAGO

Central Station Managers:



Allis-Chalmers Induction Motor

A satisfied customer is your best advertisement. His satisfaction with "Electric Service" depends largely upon his experience in its application to his particular problems. If he has had motor troubles he is not likely to be an enthusiastic booster for electric power.

Your own interests therefore require that the motors on your power lines should not only be efficient but thoroughly reliable.

We are anxious for you to know how completely

Allis-Chalmers Motors

meet these requirements — how design, workmanship and materials all contribute to make a dependable motor—how rugged construction, moisture-proof coils and dust-proof bearings give added ability to meet emergency conditions and insure long life and low maintenance charges.

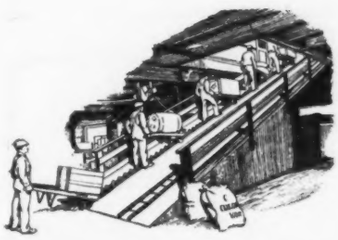
Our bulletins describe these motors. Our offices will be pleased to tell you more about them and to assist in the selection of a motor for any particular service.

Allis-Chalmers Manufacturing Company

Milwaukee, Wisconsin

Offices in all principal cities.

Latent Prospects for Larger Revenue



Otis Inclined Elevator in the Terminal of the Pére Marquette Railroad, Third and Congress Sts., Detroit, Mich.

The docks, the factories, the loft buildings, the railway terminals, the department stores—all are latent prospects for the larger current revenues that come to the Central Station from the use of

OTIS INCLINED ELEVATORS

Working on the principle of Escalators, these Elevators are arranged to carry trucks instead of people. Rapid and continuous in their operation, they form a most economical mode of moving package freight from lower to upper floors or levels. In constant use, often running both day and night, their use is no less profitable to Central Station than to the users.

Let us send you literature showing you the many uses made of the Inclined Elevator and work with you in extending this valuable motor drive.

Otis Elevator Company

Eleventh Ave. and Twenty-Sixth St., New York

Offices in All Principal Cities of the World

Adhmi

Over in India you can hire a servant for almost nothing per week. And there are lots of them too. "An easy solution of the servant problem!" you unthinkingly exclaim.

No, sir. Emphatically NO! You see it's like this. The servants are specialists; each proud in his restricted sphere of activity in serving—the master of the boots, the master of the pup and so on *ad nauseam,* so that when you mobilize your flock and totalize their stipend you are paying more than you would for an acclimated servant in suburban New York.

And reasoning along the same lines don't think for a minute that because a carbon brush is cheap that you're going to get off easy on brush bills. You are NOT. That's the crudest kind of folly. You are going to pay a *whole lot* more *per annum* for such brushes than you would pay per annum-and-a-half for *prescribed* Morganite brushes.

Have you ever thought that back in your very own plant you might be financing a carbon brush leak? Ask us to submit some figures on the subject.

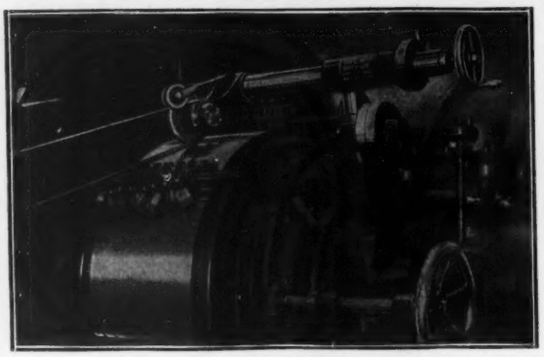
The Morgan Crucible Company Limited
116 Liberty St, New York City

Factory, Brooklyn, N. Y.

AGENTS:

Lewis & Roth Co., 312 Denckla Bldg., Philadelphia

Electrical Engineering & Mfg. Co.
First National Bank Bldg., Pittsburgh



"Satisfactory in Every Sense of the Word"— Catskill Illuminating & Power Co. Catskill, N. Y.

The JORDAN Commutator Truing Device

"Every sense of the word" is what these people say. Think over *your* commutator truing problems—then reconsider this critical user's verdict. In our catalog No. 3 you will find operating details that will interest you. A copy?

↓

Are you going to find out WHY?

JORDAN BROTHERS, Inc.
80 BEEKMAN STREET NEW YORK CITY
41213 2

Reliance Adjustable Speed Motors

Run at any speed over any range up to 1 to 10.
No electric controller used.
Reliance Electric & Engineering Co.
1046 Ivanhoe Road, Cleveland, Ohio

ALEBAUGH

No Spark Brushes
Save Commutators, Power, Brush Cost
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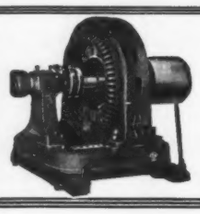

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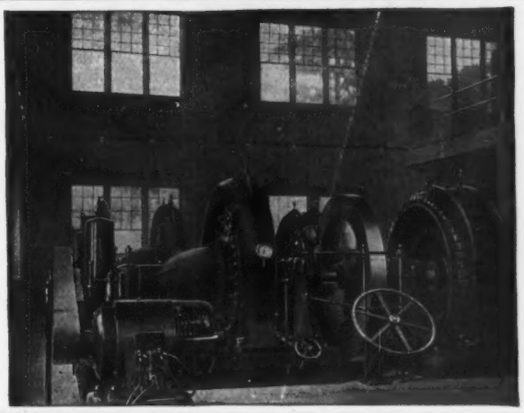

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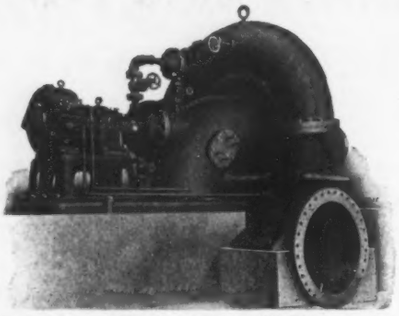

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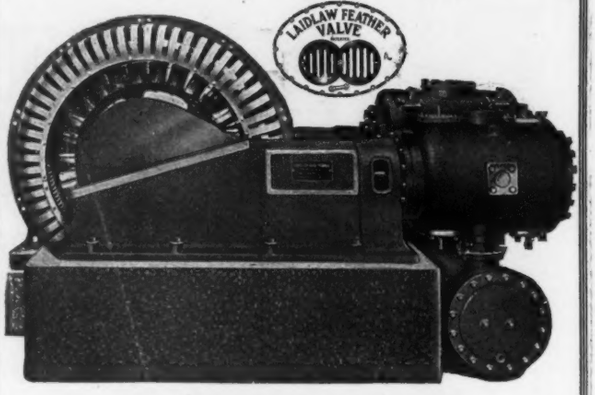

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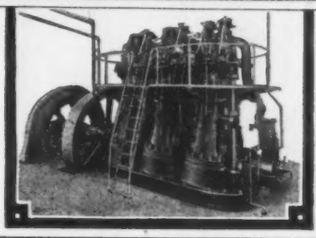

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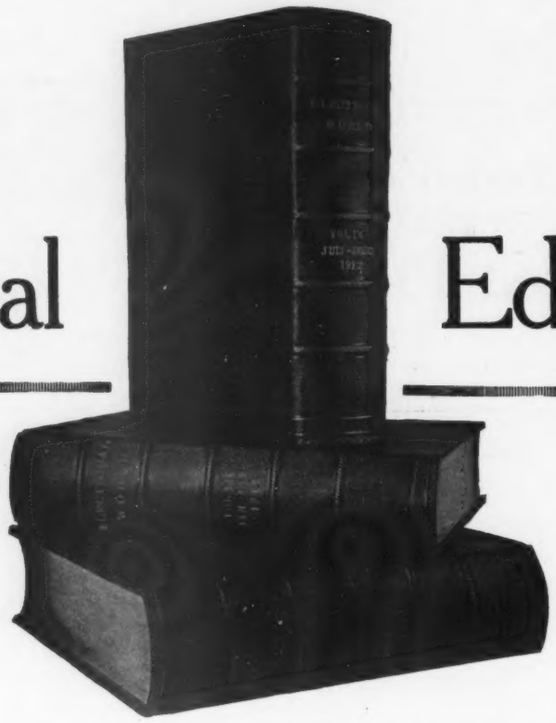

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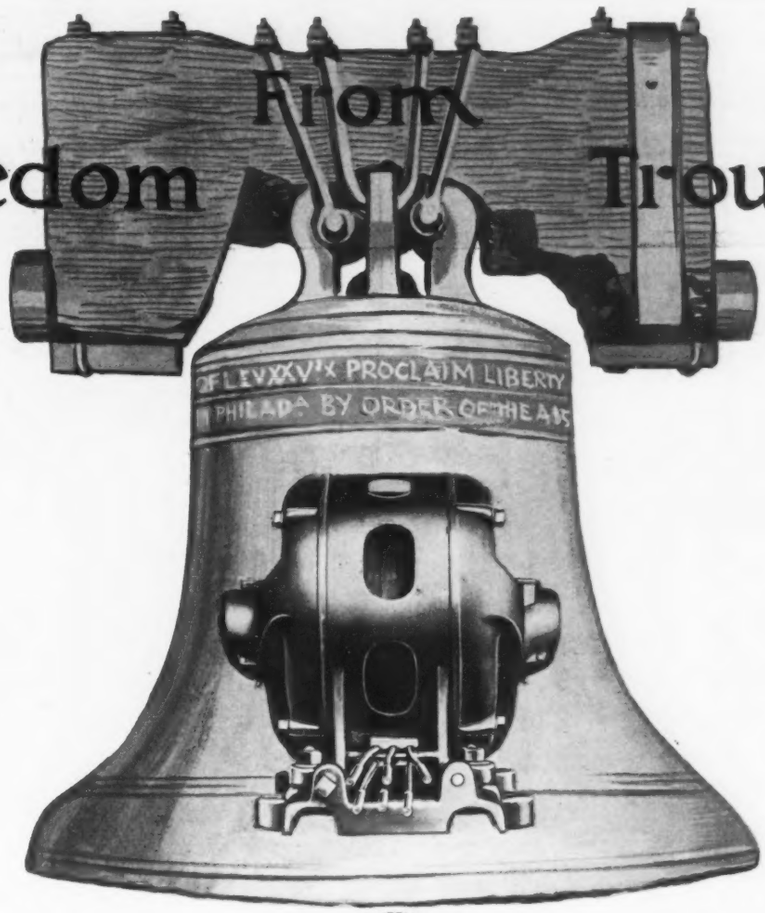

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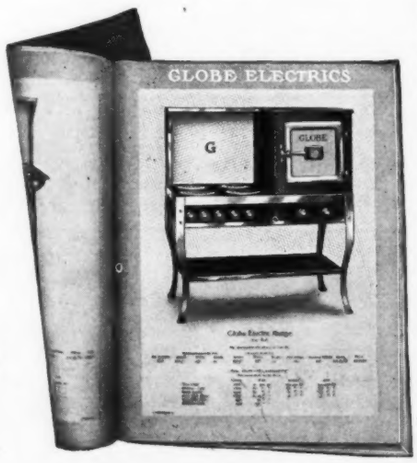

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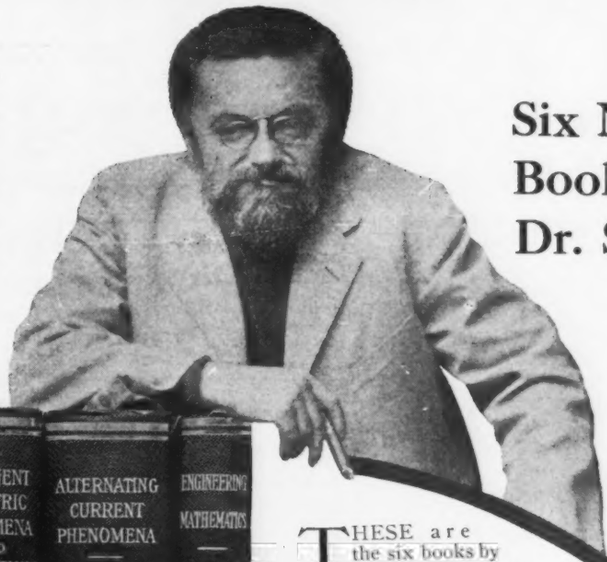

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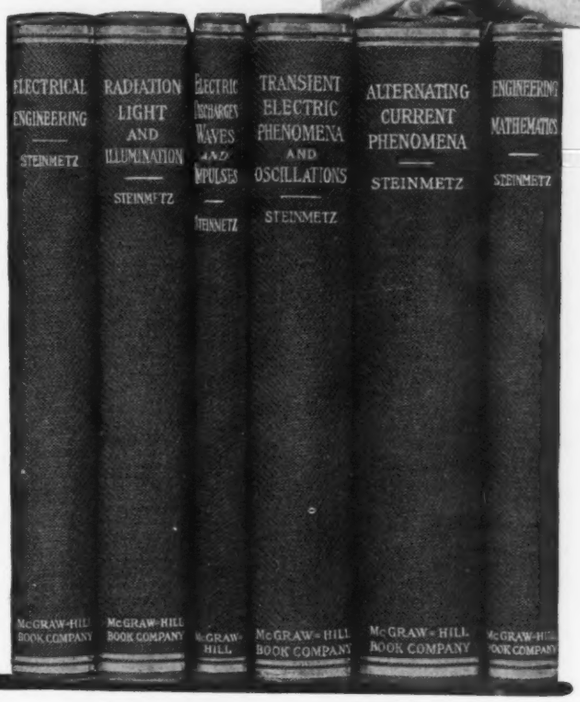

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1	100	Westinghouse, rev. field, 2300 volts, direct-con. Erie City engine	277
2	115	Allis-Chalmers, rev. field, 2300 v.	900
1	120	Gen. Elec., single-phase, 2300 v.	900
1	120	Westinghouse, 2200 volts	720
1	150	Westinghouse, rev. field, 2300 volts	450
1	200	Gen. Elec., A.T.B., revolving field, 2300 volts	600

220 Volt Generators—D.C.

	K.W.		Speed
1	6½	Crocker-Wheeler	1100
1	10	Fairbanks-Morse	875
2	12½	Colonial	1200
1	13	Western Elec.	650
1	25	Gen. Elec., CL.	1050
1	35	West'house, 3-wire	1050
1	35	Gen. Elec. Curtis turbine	3600
1	50	Allis-Chal., Ridgeway Self-oiling engine	275
1	75	Gen. Elec., type DLC, interpole	700
1	75	Allis-Chalmers	460
1	85	Westinghouse	750
1	100	Western Elec.	575
1	100	Westinghouse, direct-con. Ideal self-oiling engine	250
1	100	Milwaukee, direct-con. to Buckeye engine	250
1	150	Willey, direct-con. to 4-valve Atlas engine.	225

H.P.		Speed
1	240	Crocker - Wheeler, MP, direct-con. to cross compound Vilter-Corliss engine. 120

220 Volt D.C. Motors

Larger sizes have been scarce, but we now have the following:

H.P.		Speed
1	25	Allis-Chalmers	700
1	30	Gen. Elec., type CL, comp.	925
1	35	Western Elec.	965
1	35	National-Lundell	900
1	35	Gen. Elec.	550
1	40	National-Lundell	600
1	45	Holtzer-Cabot	275
1	50	Western Elec.	950
1	50	Westinghouse	900
1	50	Allis-Chalmers	850
1	50	Sprague-Lundell	645
1	75	Gen. Elec., CL, interpole	400
1	85	Gen. Elec., type CL.	750
1	90	Western Elec.	525

H.P.		Speed
1	100	Westinghouse	675
1	100	Westinghouse	650
1	100	Allis-Chalmers	400
1	105	Gen. Elec., CL.	630

Three Phase, 60 Cycle Motors

H.P.		Speed
3	35	Gen. Elec.	1800
15	50	Gen. Elec.	1200
1	50	Gen. Elec., form L.	1200
1	50	Allis-Chalmers, slip-ring, self starter	690
1	65	Gen. Elec.	1200
1	75	Gen. Elec.	720
2	100	Gen. Elec.	1200
1	100	Gen. Elec.	720
1	120	Gen. Elec.	1200
1	125	Gen. Elec.	1200
8	125	Westinghouse, slip-ring	580
1	150	Westinghouse, 2300 volts, American centrifugal pump	1120
1	200	Gen. Elec., 2300 v.	600
1	200	Westinghouse 2400 v. synchronous motor complete	900

Generators

3 phase, 60 cycle, 2300 volt

75 kw. General Electric, form P	$475
100 kw. General Electric, type ATB	550
200 kw. General Electric, type ATB	800
250 kw. Westinghouse, direct-connected Penn. cross-compound Corliss engine, 180 r.p.m.	3,500
1200 kw. Westinghouse, direct-connected Rice & Sargent cross-compound engine	

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200 Kw. Westinghouse Generator, 3 phase, 60 cycle, 440 volts, 900 r.p.m., with belted exciter.
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3—	400	Westge.	250	..	150	18&36x36 Porter Allen 4 Valve
	350	Ridgway	275	..	150	26x28 Ridgway Heavy Duty
2—	350	Keystone	250	..	90	18&36x36 Nordberg C. C. Cor.
2—	300	Cr.-Wh.	250	8	145	20&41x18 Ball Wood Vert. Cor. C.C.
	300	Cr.-Wh.	250	10	150	20&31x24 Chuse 4 Valve
2—	250	G. E.	250	..	200	26x18 Ball & Wood
	200	Westge.	250	..	180	17&28x20 Ridgway H. T. C.
	200	Westge.	250	8	190	14½&28x18 Harrisburg T.C. 4 Valve
2—	150	Westge.	250	..	200	18x18 Harrisburg side crank
4—	130	Ft. Wayne	125	6	250	13&16x22 Ideal Center Crank T. C.
	125	G. E.	3 Wire	4	2400	Curtis Hor. St. Turbine
	100	Westge.	250	6	250	16x14 Ideal Side Crank
	75	All.-Ch.	250-275	..	..	4 Cyl. Bruce-McB. Gas
2—	75	C.-W.	250	..	275	15x12 Harrisburg Engines
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One ATB 16-250 pole, 250 kw., 450 rev., 2300 volt, form P, 3 phase, 60 cycle revolving field General Electric alternator in excellent condition, with switchboard, exciter, oil switch and potential transformer for use with instruments on switchboard. George Q. Moon & Co., Inc., Binghamton, N. Y.

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In a growing town of 1000 near Cincinnati. Cash price $3,850, or $4,000 on time, requiring $2,000 down, balance on terms to suit. This is an exceptional opportunity for a young man to get into this business. Other business requires owners' attention, hence the sacrifice. Box 1135, Elec. World.

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FOR SALE

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WANTED—Draftsman familiar with detailing on induction motors and transformers. Apply Box 1249, Elec. World.

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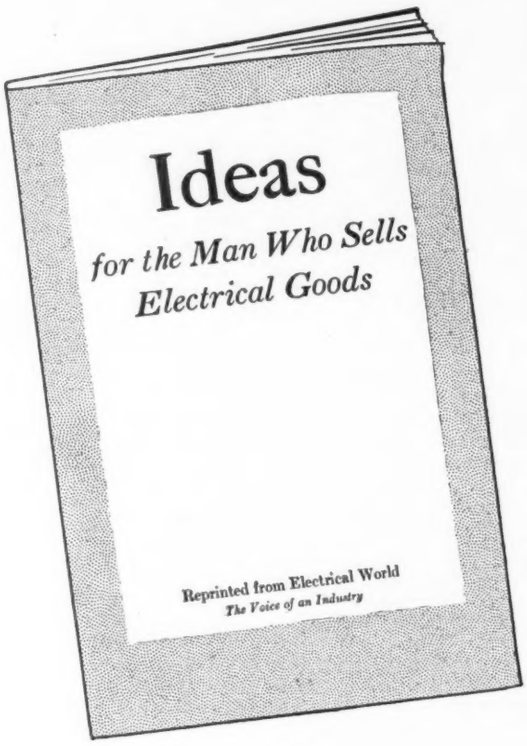

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Classified Index of Products of Representative Manufacturers and Dealers Advertising in This Issue

Air Compressors.
Allis-Chalmers Mfg. Co.
General Electric Co.
International Steam Pump Plant.
Platt Iron Works.

Aluminum.
Aluminum Co. of America.

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(See Instruments, Electrical.)

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Annunciators.
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Batteries, Dry Cell.
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Batteries, Storage.
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General Lead Batteries Co.

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Fahnestock Electric Co.

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Norma Co. of America.
S K F Ball Bearing Co.

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Babcock & Wilcox Co.

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Hubbard & Co.

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Roller-Smith Co.

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Ridgway Dynamo & Engine Co.
Westinghouse Elec. & Mfg. Co.

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Metropolitan Eng'g Co.

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General Electric Co.
Jeandron, W. J.
Morgan Crucible Co., Ltd.

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Haywood Co.

Buildings, Steel.
Blaw Steel Cons. Co.

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Calebaugh Self Lubricating Carbon Co.
Morgan Crucible Co., Ltd.

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Industrial Controller Co.
Monitor Controller Co.
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Westinghouse Elec. & Mfg. Co.

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Diamond State Fibre Co.

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Samson Cordage Works.

Cord, Flexible.
American Electrical Works.
Belden Mfg. Co.
General Electric Co.
Rome Wire Co.

Cord, Trolley.
Samson Cordage Works.

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Crocker-Wheeler Co.
Sprague Electric Works.
Westinghouse Elec. & Mfg. Co.

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Maris Bros.

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G & W Electric Specialty Co.
Metropolitan Eng'g Co.

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Col's Die, Tool & Machine Co.

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Hubbard & Co.

Drills, Elec.
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C & C Elec. & Mfg. Co.
Century Electric Co.
Crocker-Wheeler Co.
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Sprague Electric Works.
Westinghouse Elec. & Mfg. Co.

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Crocker-Wheeler Co.
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Robbins & Myers Co.
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Locke Insulator Mfg. Co.

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Lamps, Flaming Arc.
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Formica Insulation Co.
Mica Insulator Co.

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Crocker-Wheeler Co.

Molded Insulations.
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Dickinson Mfg. Co.

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Carlisle & Finch Co.

Oil, Cylinder.
(See Lubricants.)

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Light & Development Co., St. Louis.

Packing.
Jenkins Bros.

Panel Boards.
Adams-Bagnall Electric Co.
General Electric Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Patent Attorney.
Andrews, E. J.
Howe, Thomas.

Penstock.
Portland Wood Pipe Co.

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Leeds & Northrup Co.

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New Process Gear Corp.

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Matthews & Bro., Inc., W. N.

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King Foundry Co.
Mott Iron Works, J. L.

Poles, Reinforcing.
Hubbard & Co.

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Bates Expand. Steel Truss Co.
Blaw Steel Cons. Co.
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Colonial Sign & Insulator Co.
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G & W Elec. Specialty Co.
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General Electric Co.
Metropolitan Eng'g Co.

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Platt Iron Works

Pumps, Centrifugal.
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Goulds Mfg. Co.
Platt Iron Works.

Pumps, Motor Driven.
Goulds Mfg. Co.
Kinetic Engrg. Co.
Platt Iron Works.

Pumps, Oil.
Goulds Mfg. Co.
Ludlow Valve Mfg. Co.
Platt Iron Works.

Pumps, Steam Driven.
Allis-Chalmers Mfg. Co.
Platt Iron Works.

Pumps, Vacuum.
Goulds Mfg. Co.
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Pumps, Water Works.
Platt Iron Works.

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Leeds & Northrup Co.

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General Electric Co.

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Carlisle & Finch Co.

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General Electric Co.
Globe Stove & Range Co.
Simplex Electric Heating Co.

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General Electric Co.
Johns-Manville Co., H. W.

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Carbondale Machine Co.

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Erie Pump & Equip. Co.

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Baruch Elec. Controller Corp.

Repairing.
Gregory Electric Co.

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General Electric Co.
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Simplex Elec. Heating Co.
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Industrial Controller Co.
Monitor Controller Co.
Simplex Elec. Heating Co.
Sundh Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

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Hart Mfg. Co.

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Duzets Sons.
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Amer. Sheet & Tin Plate Co.

Sheets, Electrical.
Amer. Sheet & Tin Plate Co.

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Signs, Electric.
Colonial Sign & Ins. Co.

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Davis Slate & Mfg. Co.
Portland-Monson Slate Co.

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Belden Mfg. Co.

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Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
Hubbell, Inc., Harvey.
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Kandem Elec. Co., Inc.
Ostrander & Co., W. B.

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General Electric Co.

Solder.
Belden Mfg. Co.

Soldering Flux.
Blake Signal & Mfg. Co.
Condit Electrical Mfg. Co.

Soldering Irons.
General Electric Co.

Solenoids.
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Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Sundh Electric Co.
Ward Leonard Electric Co.

Speedometers.
Keystone Elec'l Inst. Co.

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American Lighting Co.

Springs.
American Steel & Wire Co.
Cary Spring Works.
Cook Spring Co.

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Campbell Electric Co.
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Blake Signal & Mfg. Co.

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Philadelphia Elec. Co. Supply Dept.

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Westinghouse Elec. & Mfg. Co.

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General Electric Co.
Roller-Smith Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Automatic Time.
Anderson Mfg. Co., A. & J. M.

Switches, Disconnecting.
Anderson Mfg. Co., A. & J. M.
General Electric Co.
Royal Elec. Mfg. Co., Inc.

Switches, Fuse.
General Electric Co.
Matthews & Bro., Inc., W. N.

Switches, Knife.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
Cutter Co., The.
Electric Controller & Mfg. Co.
General Electric Co.
Metropolitan Eng'g Co.
Trumbull Elec. & Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Oil.
Condit Electrical Mfg. Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

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Delta-Star Elec. Co.
Elec'l Engineers Equip. Co.
General Electric Co.
K-P-F Elec. Co.
Royal Elec. Mfg. Co.

Switches, Remote Control.
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Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
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Switches, Series.
G & W Elec. Specialty Co.

Switches, Snap and Push Button.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
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Switches, Time.
Campbell Electric Co
Paragon Electric Co.

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Newton Mfg. Co.

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Esterline Co.
Foxboro Co., The.
Keystone Elec'l Inst Co.

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Manhattan Elec'l Supply Co.

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Esterline Co.
Keystone Electrical Inst. Co.
Leeds & Northrup Co.
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Tools, Linemen's.
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Bates Expand. Steel Truss Co.
Blaw Steel Cons. Co.
Coombs, R. D.

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Campbell Electric Co.
Crocker-Wheeler Co.
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General Electric Co.
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Trump Mfg. Co.

Water Wheel Governors.
Ludlow Valve Mfg. Co.
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Okonite Company, The.
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Portland Wood Pipe Co.

Wood Preserving.
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NOTICE TO ADVERTISERS:

Printing begins on Saturday of each week.
Changes of copy received up to 10 A. M. Saturday will appear in the issue of the following week, but no proofs can be submitted for OK before publication.
New Advertisements (not changes of copy) received up to Tuesday noon can appear in the issue of that week, but no proofs can be shown.
If proofs before printing are required changes of copy and copy for new advertisements must be in our hands two weeks in advance of the date of publication.

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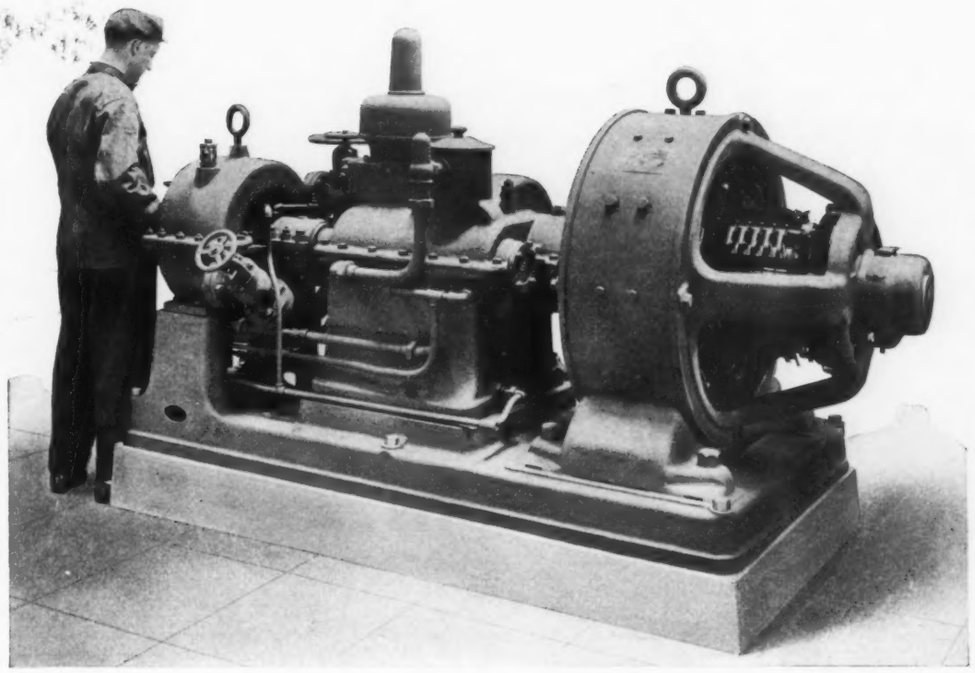
Full Load Efficiency
At Light Loads



100 KW Direct Current Geared Set

Your plant load may have increased 100% by this time next year. Therefore, you need a prime mover which will give you as good economies on the load carried today as on the load you may carry a year from now.

Or there may be a wide difference between the day and the night loads carried. You want good economies over the whole load range.

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Denver, Colo.
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Joplin, Mo.
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San Francisco, Cal.
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Washington, D. C.
*W. E. & M. Co. of Texas

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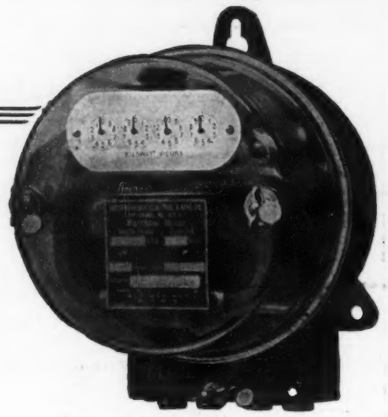
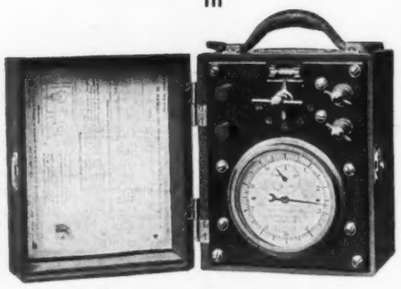


Type OA Watthour Meter

Mr. Central Station Manager:

Your entire revenue is determined by your watthour meters. —See that their accuracy is maintained by periodical testing with proper standards.



Rotating Standard Single-Phase Watthour Meter

Westinghouse Precision Standards

supplemented by portable standards, have enabled many central stations to save thousands of dollars in revenue by improving the average accuracy of their service meters.

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Send for Catalogue Sections DS-965 and DS-326 describing our Precision Standards and Portable Rotating Standard Watthour Meters.

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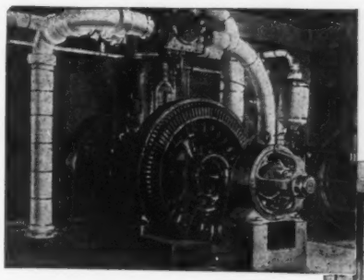
Westinghouse Alternators have Mica-Insulated Armature Coils

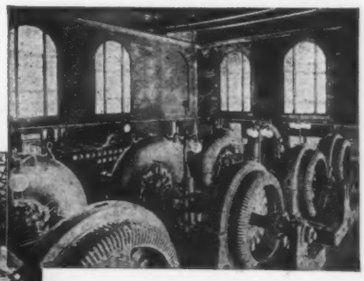
MICA is resilient and springy, holding coils tightly in the slots. It is one of the strongest insulating materials known; is unaffected by static discharge; and is uninjured by very high temperatures.

Mica has been used by the Westinghouse Company for over twenty years, and during this long experience it has perfected its designs, its shop equipment for manufacture and its methods of applying mica to armature coils.

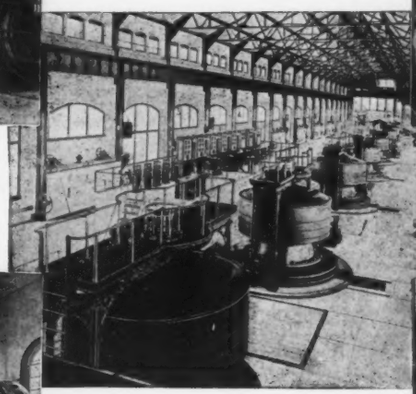
Long Life and Continuity of Service require its use on large capacity, and high voltage alternators; smaller units are better when it is used.



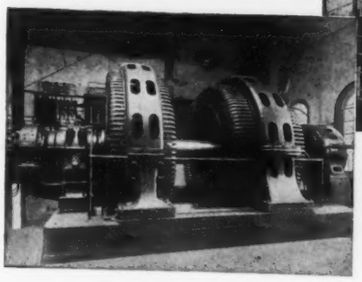
A 250 Kva., 2400 Volt, Steam-Driven Unit Mica Insulated Generator.



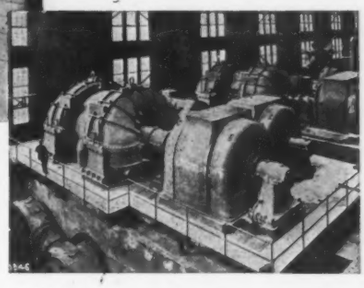
Four 1000 Kva., 13,800 Volt Water Wheel Driven Units. Mica Insulated Generators.



The First Large Water Wheel Units Installed in America. Generators Mica Insulated. Twenty Years' Service. Still Good.



A 6800 Kva. Frequency Changer Set 13,200 and 4000 Volt Alternators, Both Mica Insulated.



A 30,000 Kw. Steam Turbine Unit. Generator Mica Insulated.

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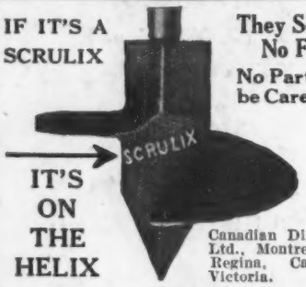

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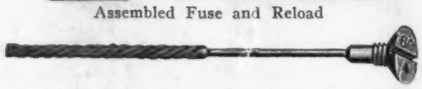

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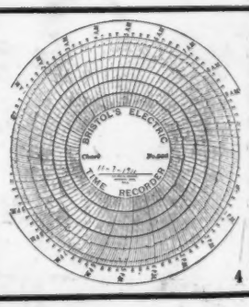
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